Railway Mechanical Engineer

December 1945

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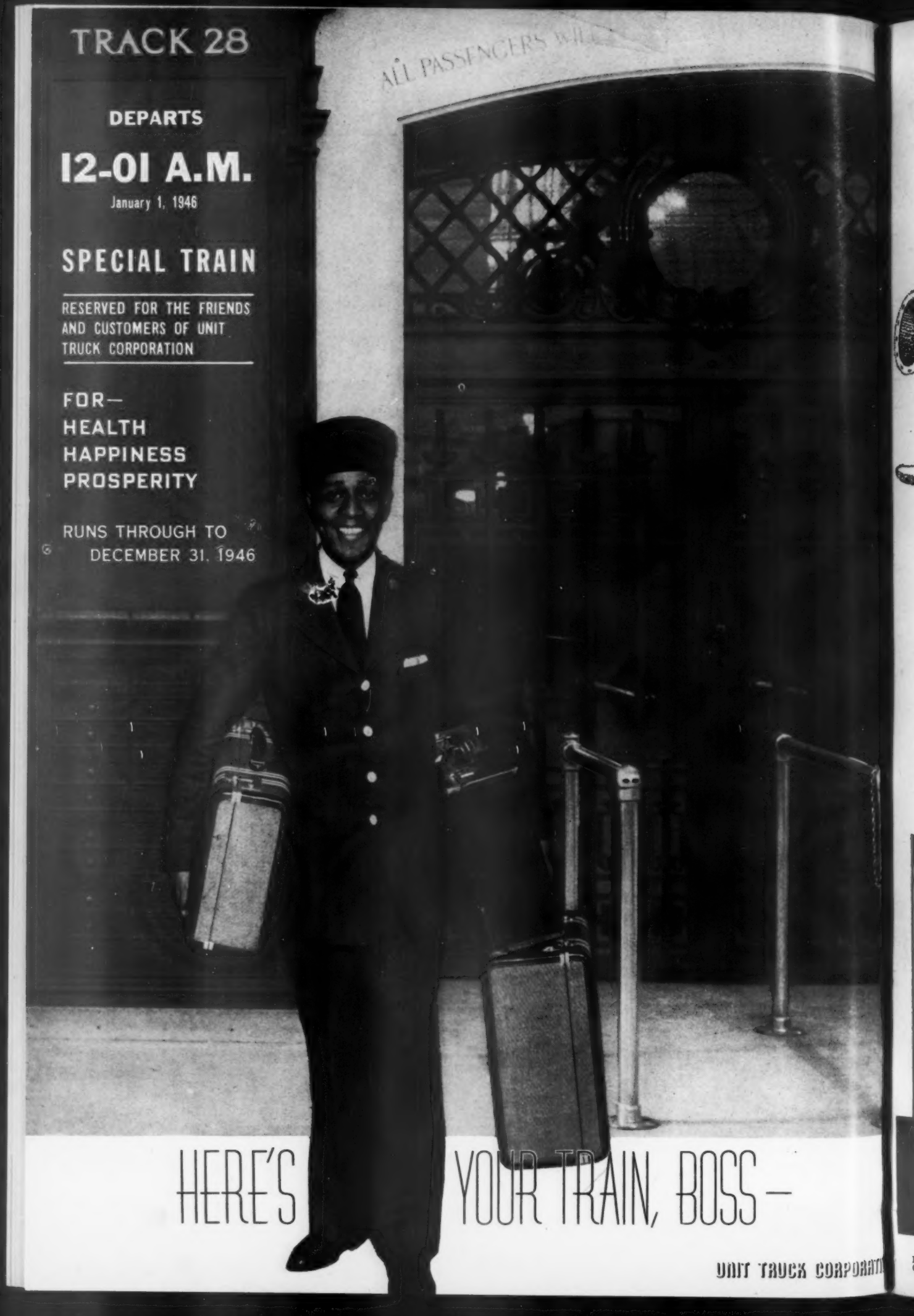
Save wheels!

..REDUCE FLANGE WEAR

Specify WINE BRAKE BALANCER

THE WINE RAILWAY APPLIANCE CO. TOLEDO, OHIO


TRACK 28
DEPARTS
12-01 A.M.
January 1, 1946
SPECIAL TRAIN
RESERVED FOR THE FRIENDS AND CUSTOMERS OF UNIT TRUCK CORPORATION
FOR—
HEALTH
HAPPINESS
PROSPERITY
RUNS THROUGH TO DECEMBER 31, 1946
HERE'S YOUR TRAIN, BOSS—
UNIT TRUCK CORPORATI

Speedily Removes Carbonized Deposits from Compressors by immersion or circulating method!

When you use OKEMCO or other recommended specialized Oakite material for cleaning compressors either by tank immersion method or "in place" on locomotives, carbon deposits, oil and grease are quickly removed from pistons, valve cages and ports. You complete the job "on time" as scheduled.

Railway cleaning problems require a comprehensive knowledge of the work to be done, the materials to use and the methods to apply. Through our Railway Service Division, you obtain the free service of experienced men, thoroughly familiar with every phase of railway maintenance and repair . . . men who work with you and for you to help complete each cleaning task "on time". You are invited to put this free service to work on your road.

ASK US ABOUT

Cleaning Air Conditioning Equipment

★

Pressure Cleaning Valve Gear

★

Cleaning Crossheads, Bearings, Journal Boxes, Brake Shoes, Etc.

★

Safely Washing Streamliners

★

Preparing Locomotive Frames For Fracture Tests

★

Back Shop Tank Cleaning

★

Safely De-scaling Diesel Cooling Systems, Oil Coolers, Etc.

★

Cleaning and Deodorizing Freight and Refrigerator Cars

OAKITE PRODUCTS, INC., WRIGLEY BUILDING, CHICAGO 11, ILL.

In Canada: OAKITE PRODUCTS OF CANADA, LTD.

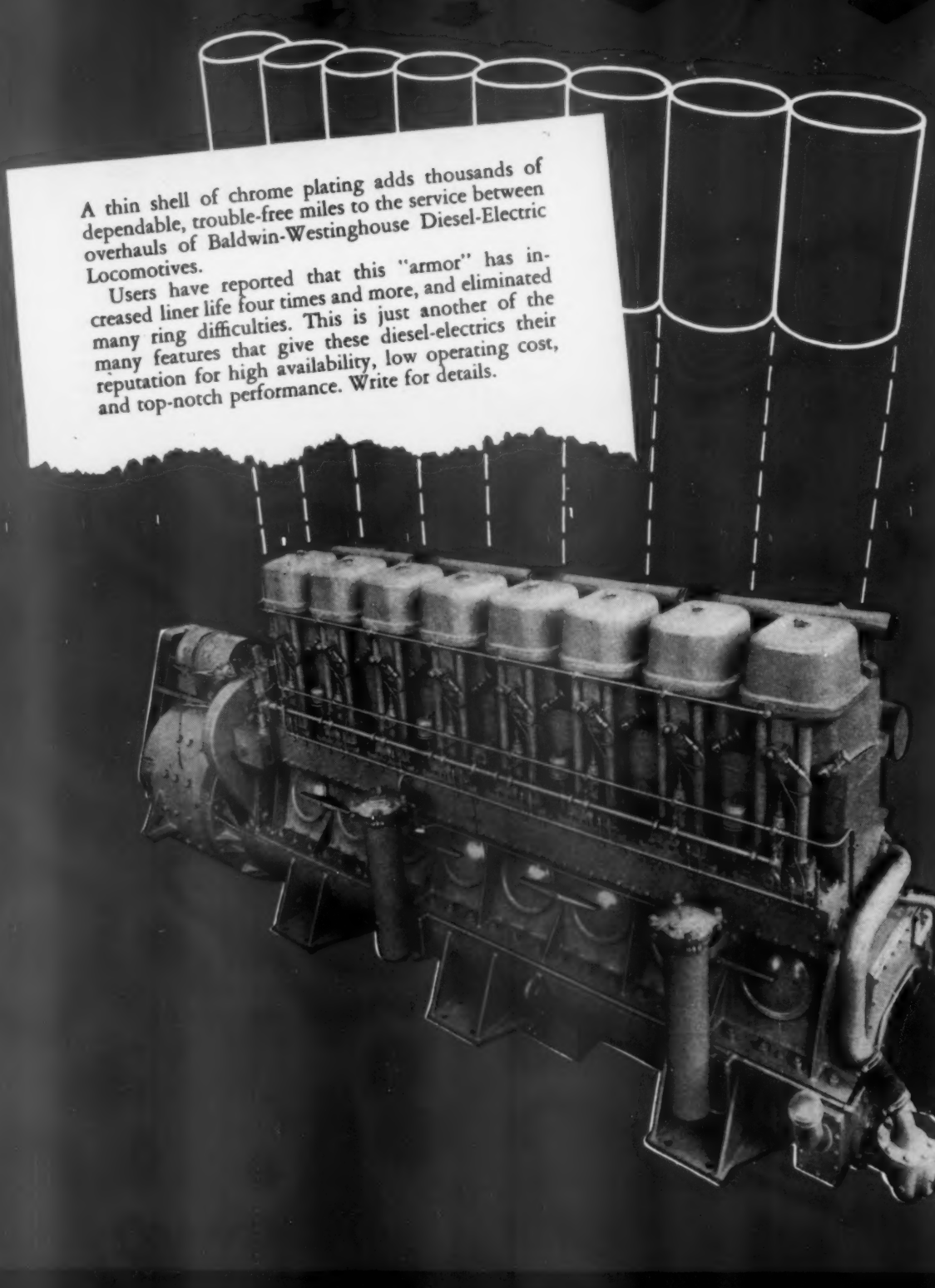
TORONTO: 65 Front St. East—MONTREAL: 1 Van Horne Ave.

OAKITE

RAILWAY SERVICE DIVISION

Published monthly by Simmons-Boardman Publishing Corporation, 1309 Noble Street, Philadelphia, Pa. Entered as second-class matter, April 3, 1933, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription price, $3.00 for one year, U. S. and Canada. Single copies, 35 cents. Vol. 119, No. 12.

"Armor"



A thin shell of chrome plating adds thousands of dependable, trouble-free miles to the service between overhauls of Baldwin-Westinghouse Diesel-Electric Locomotives.

Users have reported that this "armor" has increased liner life four times and more, and eliminated many ring difficulties. This is just another of the many features that give these diesel-electrics their reputation for high availability, low operating cost, and top-notch performance. Write for details.

multiplies liner life

in Baldwin-Westinghouse Diesel-Electrics

THE **BALDWIN-**

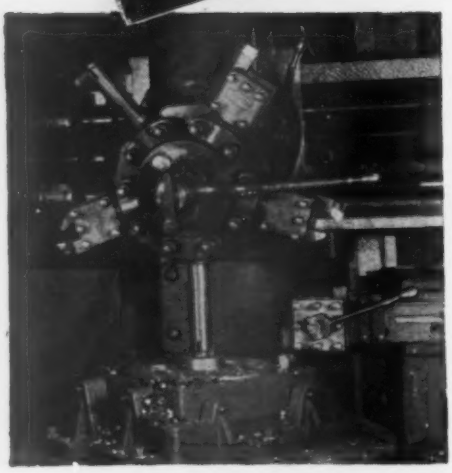
LOCOMOTIVE WORKS, PHILADELPHIA

Westinghouse

ELECTRIC CORPORATION, EAST PITTSBURGH, PA.

TAKE FULL ADVANTAGE OF YOUR MACHINE'S *Ability!*

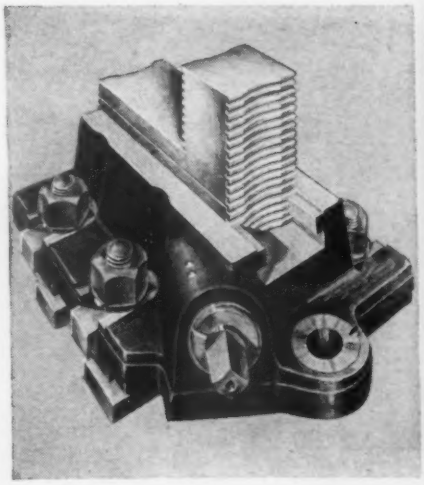
Send FOR THIS FREE CATALOGUE..JUST WRITE ON YOUR COMPANY STATIONERY

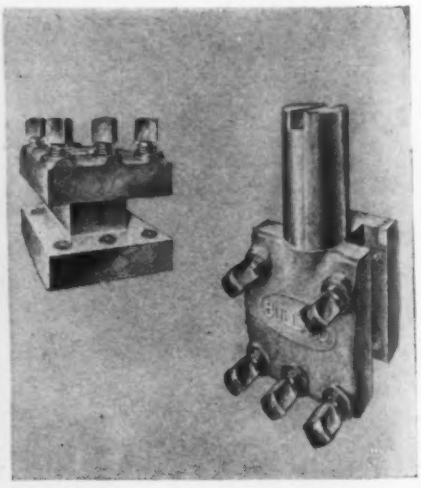


A machine's ability to perform is basically in the machine itself, but no matter how good the machine, it may be hampered by lack of good tools.

Balanced equipment is a valuable asset. Bullard general purpose Standard Tool Equipment for Vertical Turret Lathes is designed for maximum performance. Rugged and quickly applicable to the machine, these tools lower the cost of "change-over" and "set-up." Properly set on the machine they provide a sequence of operations which cuts time between cuts, as well as on cuts.

For your old Bullard Vertical Turret Lathes or your new machines, use Bullard Standard Tools. Ask for catalog RM-STC 7-12-44. This book should give you some profitable tooling ideas.

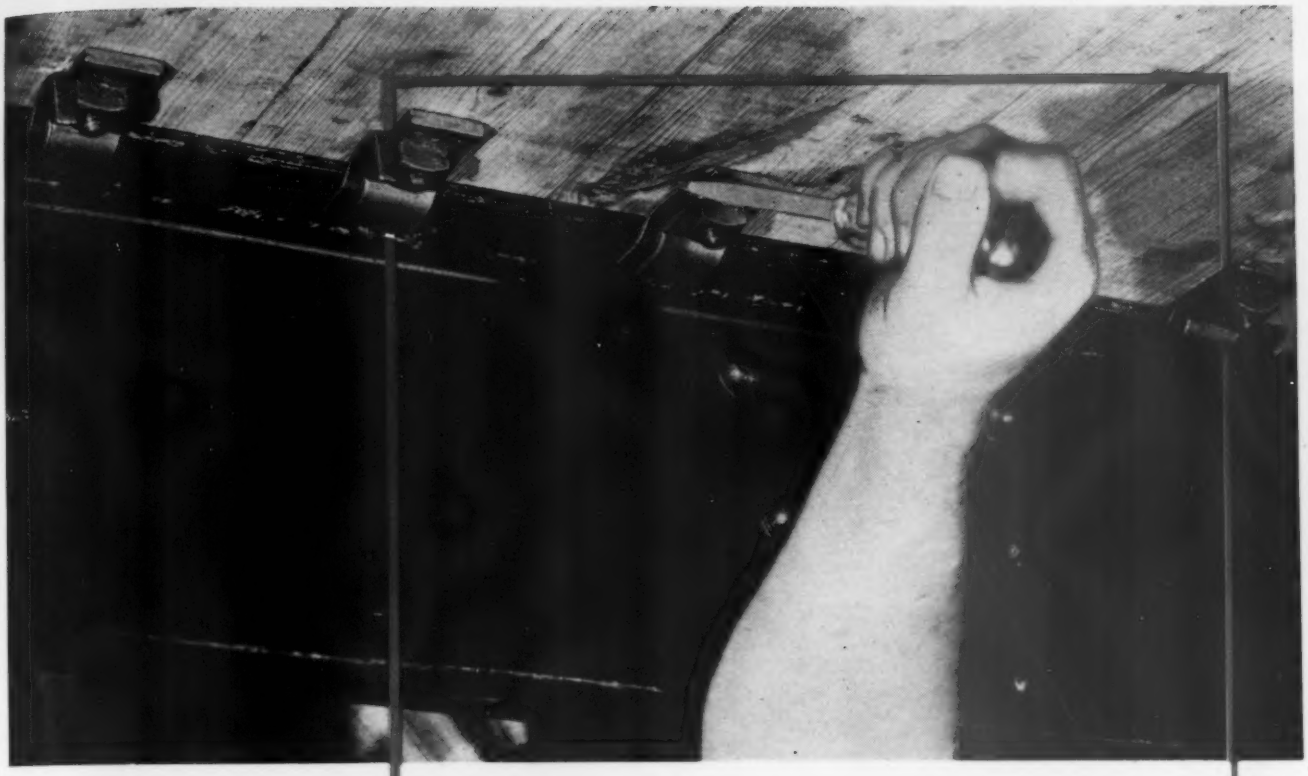




THE BULLARD COMPANY

"Manufacturers of Machine Tools"

BRIDGEPORT 2 CONNECTICUT

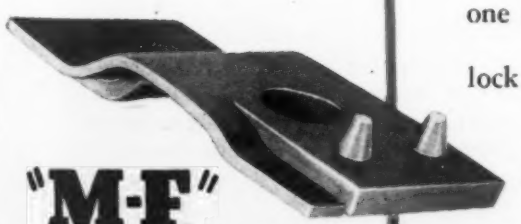


Applying the Integral Nut Lock

The "M-F" Lock-tight Floor Clip has a flange along one side. Bend it down and you have a positive nut lock ... self-contained ... a part of the Floor Clip.

Furthermore, the Floor Clip can be used over and over ... no extra parts are required.

The "M-F" Lock-tight Floor Clip alone contains this feature.

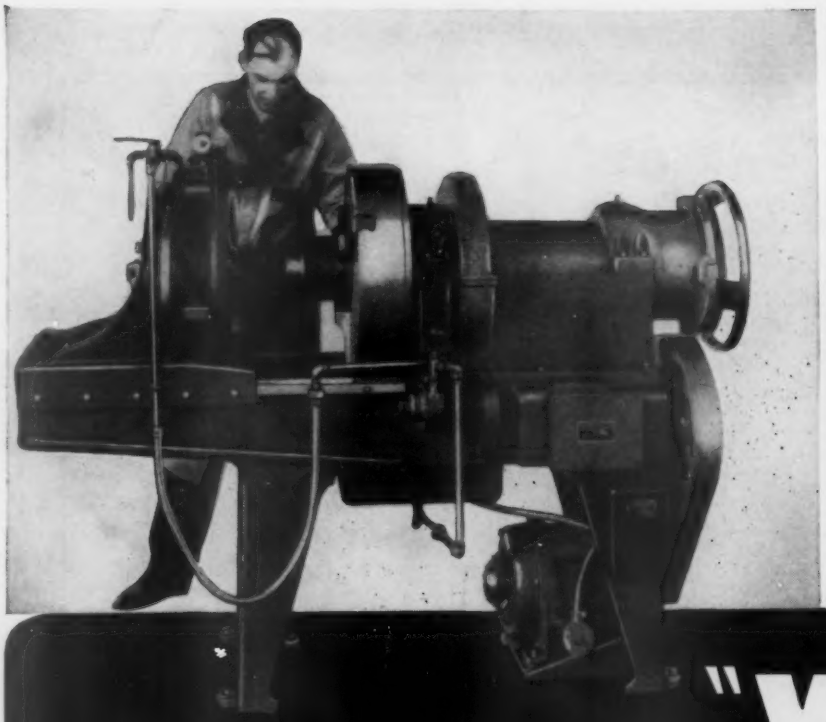


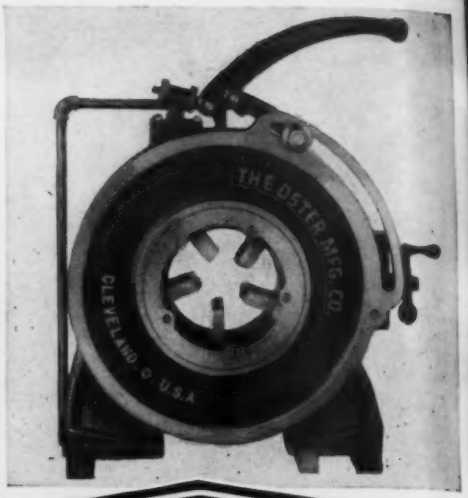
"M-F"
Lock-Tight
FLOOR CLIPS

"M-F" Lock-tight Floor Clips simplify the removal and replacing of floor boards. They save time and labor ... they can be applied at any point.

MACLEAN-FOGG LOCK NUT COMPANY

2649 N. Kildare Avenue, Chicago 39, Illinois • ***In Canada: The Holden Co., Ltd., Montreal***





OSTER

The Dual Purpose "WILCO" Threading Machine

OSTER "WILCO" PIPE THREADING SPEEDS!

No. 704 "WILCO"

Pipe Size	*Threading Time*
1″	16 seconds
1¼″	16 seconds
1½″	24 seconds
2″	25 seconds
2½″	38 seconds
3″	40 seconds
3½″	56 seconds
4″	58 seconds

No. 706 "WILCO"

Pipe Size	*Threading Time*
1½″	19 seconds
2″	20 seconds
2½″	30 seconds
3″	31 seconds
3½″	48 seconds
4″	49 seconds
5″	70 seconds
6″	74 seconds

Note: Above time studies based on cutting full American National Standard pipe threads at recommended speeds.

Easy operation and threading speeds of Oster "WILCO" pipe machines recommend them for either production or maintenance threading. In many shops they serve the dual purpose.

The "WILCO" die-head and one set of holders and chasers thread the standard range of each machine. A simple adjustment of the cam lever sets chasers to any size of pipe. The lever is equipped with a micrometer adjustment for extreme accuracy in setting chasers for any depth thread desired.

Regular equipment furnished with each machine includes one complete set of right hand, *high speed steel* pipe chasers with holders, threading all sizes within regular range; cut-off device with three centering guides; *high speed steel* cut-off tool; *high speed steel* reaming and chamfering forming tool; oil pump and reservoir; three-jaw, gripping chuck on front of spindle; four-jaw centering chuck on rear of spindle; motor of required standard specifications and non-reversing, magnetic controls.

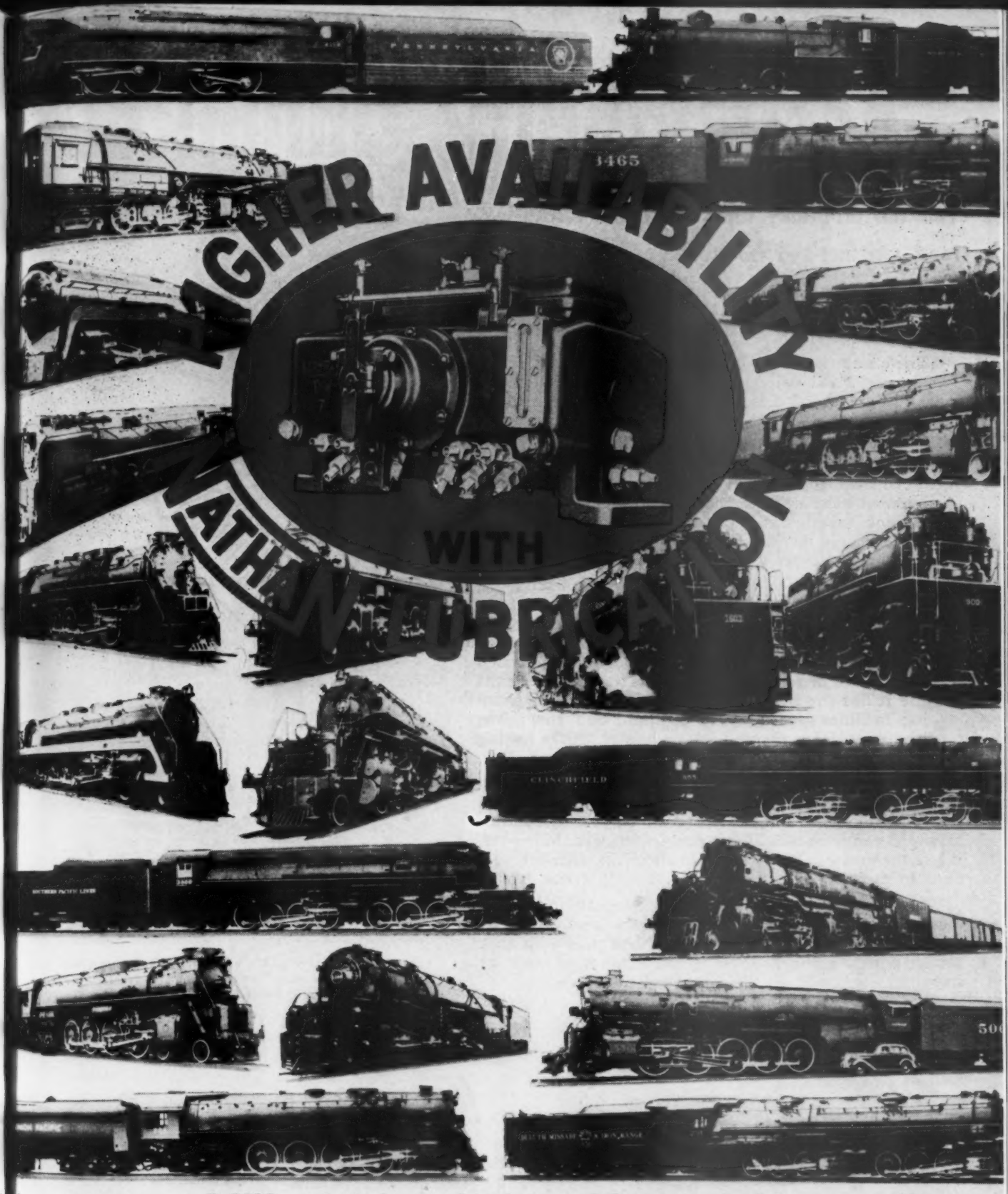
Two "WILCO" Models

No. 704. Standard range 1″ to 4″ pipe. Extra range ½″ to ¾″ pipe. Bolt range ¾″ to 3″.

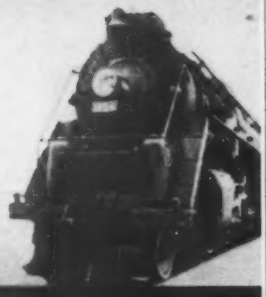
No. 706. Standard range 1″ to 6″ pipe. Bolt range 1″ to 4″.

There's an Oster Distributor near you. If you don't know his location, write us for complete details.

THE OSTER MANUFACTURING COMPANY, 2030 EAST 61st ST., CLEVELAND 3, OHIO, U. S. A.



HERE are typical examples of some of the most powerful and biggest revenue producers — and all equipped with NATHAN Mechanical Lubrication. Some of these locomotives have as many as 230 points of lubrication. Every day brings new evidence that NATHAN'S thorough lubrication, and that includes a complete job of chassis lubrication, increases the availability of locomotives and makes them more reliable, cheaper to operate and easier to inspect and maintain.



NATHAN MANUFACTURING CO. 250 PARK AVE. NEW YORK 17, N. Y.

Established 1864

Assignability Unlimited!

You can profitably utilize all of the Alco-G.E. road switcher's 95% average availability—it has the versatility to handle all three railroad jobs: road work, transfer service, and switching.

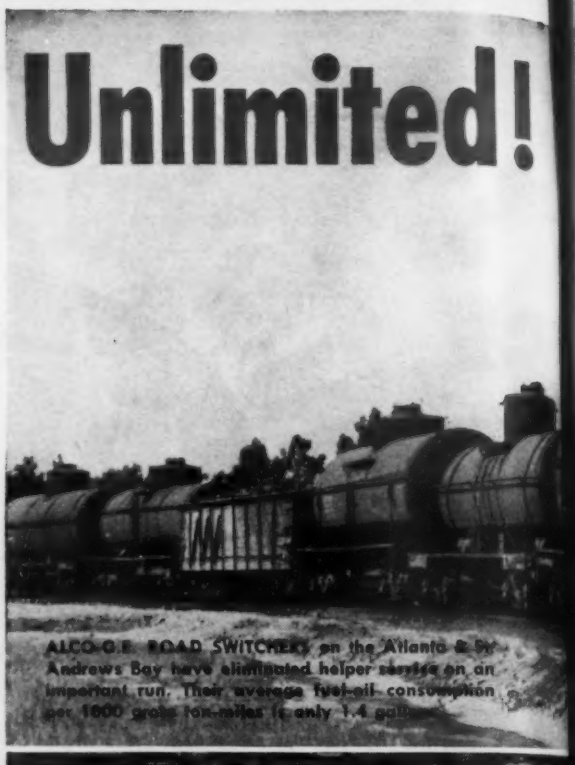
● There's almost no limit to the earning capacity of our 1000-hp road and switching locomotive. To the inherent high availability of diesel-electrics, Alco-G.E. has given to this unit an all-round versatility that enables you to keep it busy around the clock, capturing the profit that results from steady employment.

On one road, the all-purpose usefulness of four of these combination units was responsible for the release of seven steam locomotives and the speeding up of freight schedules —despite heavily increased traffic. On another road, where three of these units are assigned to switching work between road trips, annual gross savings amount to more than $90,000—a 33 per-cent return on the investment.

For switching, you'll find that it is equipped to give full power at all speeds, that it has almost unlimited visibility, and the built-in reliability that's characteristic of all Alco-G.E. diesel-electrics. It meets road requirements because it has the additional features of space for train-heating facilities, speed up to 60 mph, and the riding qualities of spring-supported, swing-bolster trucks having ample distance between centers for flexibility.

Because you can assign this diesel-electric to switching during the night and meeting road schedules during the day, you can realize a higher net return on your investment than you can from a single-purpose locomotive. Moreover, it has the greatest opportunity to effect the savings you'll need to meet the severe competition for postwar traffic.

Whether your plans to meet this competition call for diesel-electric, electric, or steam locomotives, we invite you to call in our engineers to work with your own on a motive-power survey. Their recommendations will be impartial—we build all three types of motive power.



ALCO-G.E. ROAD SWITCHERS on the Atlanta & St. Andrews Bay have eliminated helper service on an important run. Their average fuel-oil consumption per 1000 gross ton-miles is only 1.4 gal.

IN A MIDWESTERN YARD, each of two 1000-hp Alco-G.E. units handled as many cars in 24 hours as released motive power handled in 28 hours.

Rock Island

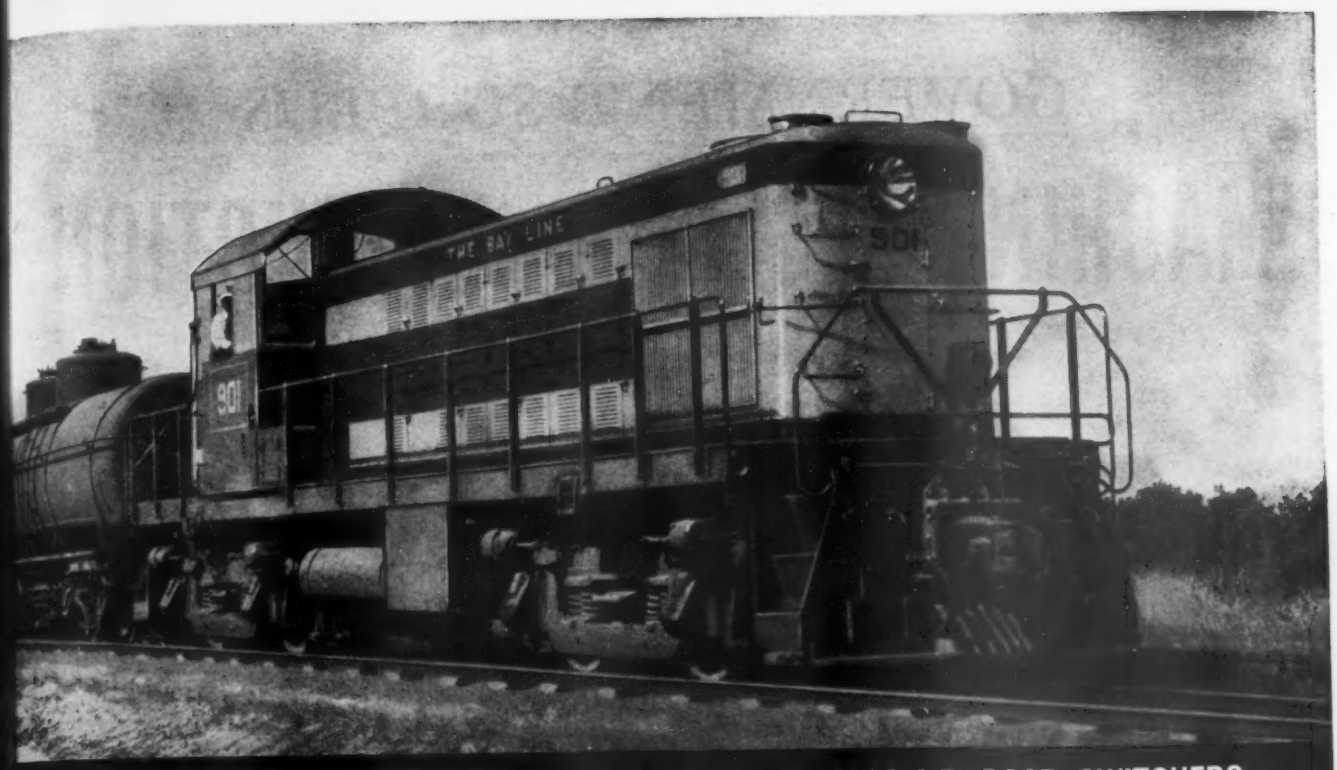
On a 498-mile section of the Rock Island, four road switchers do the complete job—switching, accumulating trains, and hauling them on the road.

Kansas City So.

Four of these 1000-hp units on the Kansas City Southern are reducing fuel costs and speeding freight movements by cutting terminal-operation time.

Alco GE

AMERICAN LOCOMOTIVE and



HOW ONE ROAD UTILIZES THE VERSATILITY OF ALCO-G.E. ROAD SWITCHERS

● On a southern line where two 1000-hp Alco-G.E. road switchers are doing double duty—road work and switching—there has been no need for additional motive power despite a 100 per-cent increase in traffic since they were placed in service. Their versatility enables this road to keep them busy at least 18 hours a day producing monthly savings of $3787 in road service and $3776 in switching.

6:30 P.M. to 4 A.M.—both locomotives, in tandem, haul 3200-ton trains over the one per-cent ruling grade of a 182-mile daily round-trip run.

4 A.M. to 3 P.M.—one of the locomotives handles local switching, and transfer work between the road's terminals and a connecting railroad.

9 A.M. to 5 P.M.—In addition to switching work at one of the yards, the other locomotive speeds passenger trains to a local resort during the summer.

Alaska

At nearly passenger-train speeds, two of these Alaska Railroad units are hauling combined freight and passenger trains where two separate trains were formerly required.

Susquehanna

On the Susquehanna, four of these versatile units are making substantial reductions in operating cost. Their daily inspection and refueling takes 20 minutes.

GENERAL ELECTRIC

113-124-9580

GOVERNMENT SURPLUS

MACHINE TOOLS and PRODUCTION EQUIPMENT

CAN HELP YOU RECONVERT!

Government-owned Machine Tools and Industrial Equipment are available now to help industry shoulder the reconversion load.

It is the responsibility of the Reconstruction Finance Corporation to dispose of these surpluses as soon as possible—to turn them over to private industry, where they'll do the greatest good for the most people in the shortest time.

Therefore, in order to speed reconversion by getting this equipment into the hands of skilled craftsmen, faster . . . we ask you to follow this simple procedure:

1. **Submit in writing your requirements for machine tools and industrial equipment to us *now*.**
2. **Send a typewritten list to your nearest R.F.C. Regional Office listed below.**
3. **Make your descriptions brief, one line if possible, clearly grouping various types of equipment you need.**

The supply of surplus tools is sufficient to meet all of the needs of industry, and in the event that your local R.F.C. Regional Office cannot fill your specific requirements, it will endeavor to locate needed equipment from other offices throughout the country.

First step in creating jobs is getting machines in motion faster.

The 31 strategically located agencies below are ready to make your reconversion problems easier.

RECONSTRUCTION FINANCE CORPORATION

A DISPOSAL AGENCY DESIGNATED BY THE SURPLUS PROPERTY ADMINISTRATION

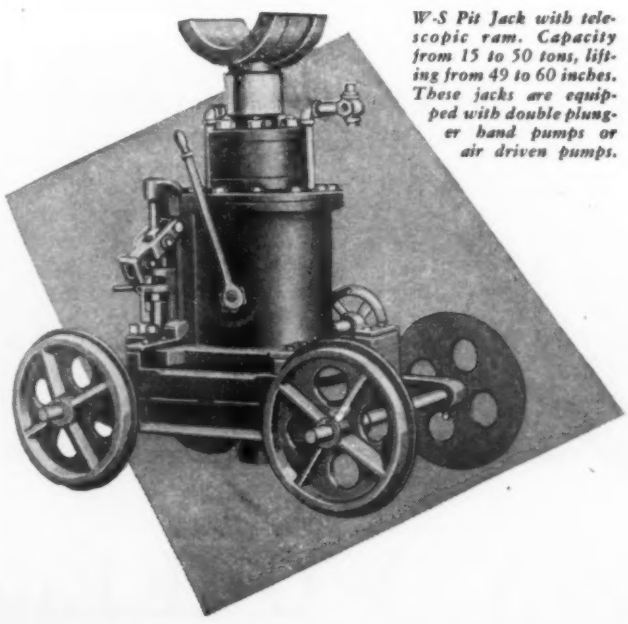
Agencies located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cleveland • Dallas • Denver Detroit • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville Minneapolis • Nashville • New Orleans • New York • Oklahoma City • Omaha • Philadelphia Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane

104

With

W-S HYDRAULIC EQUIPMENT

In round house and repair shop, Watson-Stillman hydraulic equipment has been known for years, along with the part it plays in assuring quick, economical performance of vital work. Whether your needs call for straightening and bending presses . . . portable and stationary rail benders . . . jacks and pit jacks, the complete range of W-S hydraulic products answers many wartime requirements on regular jobs and in emergencies. These machines and equipment benefit by a distinctive background of engineering and hydraulic experience. Count on them to stand up under the increased work loads caused by troop movements and other essential transportation demanded by the nation. The Watson-Stillman Co., Roselle, N. J.



W-S Pit Jack with telescopic ram. Capacity from 15 to 50 tons, lifting from 49 to 60 inches. These jacks are equipped with double plunger hand pumps or air driven pumps.

W-S PIT JACK

Watson-Stillman Pit Jacks are operated on the hydro-pneumatic principle and may be powered by either hand or air operated pumps. The jack with the telescopic ram, shown here, is most convenient for use in shallow pits. The cylinder is only half as long as in the plain type, thus providing a minimum height above the rails and eliminating the need for a sub-pit. Bulletin B-8 gives complete details and specifications of these jacks.

WATSON-STILLMAN

Designers and Manufacturers of Hydraulic Equipment, Forged Steel Fittings, and Valves

MAINTENANCE TOOL FOR PRODUCTION!

The punch capacities of "Buffalo" Universal Iron Workers range from 13/16" x 7/16" to 1¾" x 1½"; shear capacities are from ⅜" to 1½" plates.

Yes, maintenance can be put on a *production basis!* You can cut, punch, sheer, notch and cope steel plate, angles, tees, beams and other forms used in industrial maintenance *far faster* with "Buffalo" Universal Iron Workers. Thousands of these "Buffalo" huskies are turning out speedier, more economical jobs in repair work, new construction and straight production work . . . in railroads, steel mills, other heavy industries. "Buffalo" Universal Iron Workers are made in a wide range of sizes. The various tools may be operated at one time, and unskilled operators need little supervision. For full details, prices, write:

BUFFALO FORGE COMPANY
174 Mortimer Street, Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

UNIVERSAL IRON WORKER

WHY SPEED NUTS ARE FIRST *with Time Study and Cost Departments*

When ALL assembly costs are down in black and white... when TOTAL net assembly costs are figured... that's when SPEED NUTS really show results in the Cost Department.

For SPEED NUTS reduce assembly costs in many ways. They completely eliminate lock washers—saving the cost of the washers *and* the time necessary to handle and install them. Moreover, hundreds of SPEED NUTS have been designed to perform multiple functions and eliminate two or more assembly parts.

SPEED NUTS are applied faster and easier to speed up assembly. They can't "clog" with paint or enamel to delay the assembly line. "Self-retaining" types of SPEED NUTS do away with expensive welding and clinching operations. And SPEED NUT spring-tension resiliency also protects porcelain, plastic or glass parts against damage in transit.

A letter describing your fastening problem will bring you full details on how SPEED NUTS will reduce YOUR total net assembly costs, too.

NOTHING LOCKS LIKE A SPEED NUT

Only SPEED NUTS provide a COMPENSATING thread lock and a SELF-ENERGIZING spring lock. As the screw is tightened the two arched prongs move inward to lock against the root of the screw thread. These free-acting prongs COMPENSATE for tolerance variations. Compression of the arch in prongs and base creates a SELF-ENERGIZING spring lock. These two forces combine to definitely prevent vibration loosening.

TINNERMAN PRODUCTS, INC. • 2029 Fulton Road, Cleveland 13, Ohio

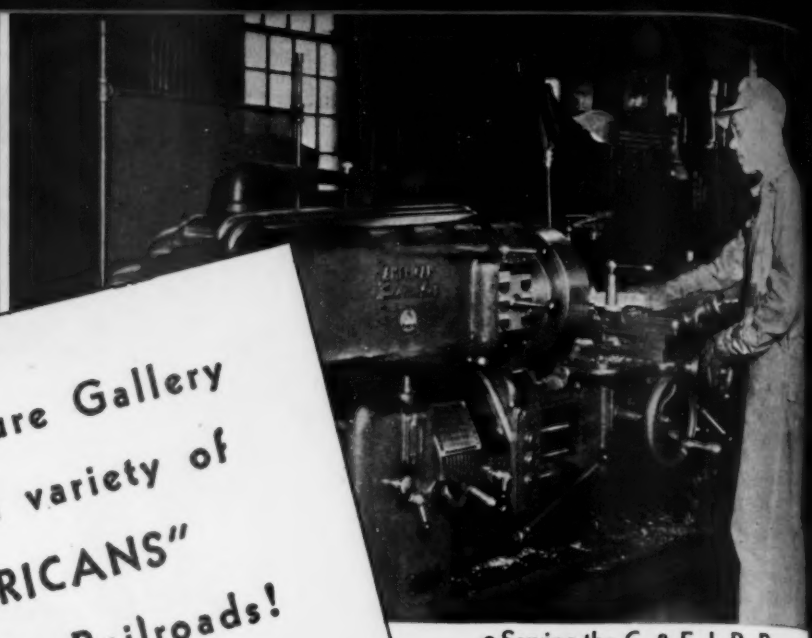
In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In France: Aerocessoires Simmonds, S. A., Paris
In England: Simmonds Aerocessories, Ltd., London
In Australia: Simmonds Aerocessories, Pty. Ltd., Melbourne

Speed Nuts PATENTED

* Trade Mark Reg. U. S. Pat. Off.

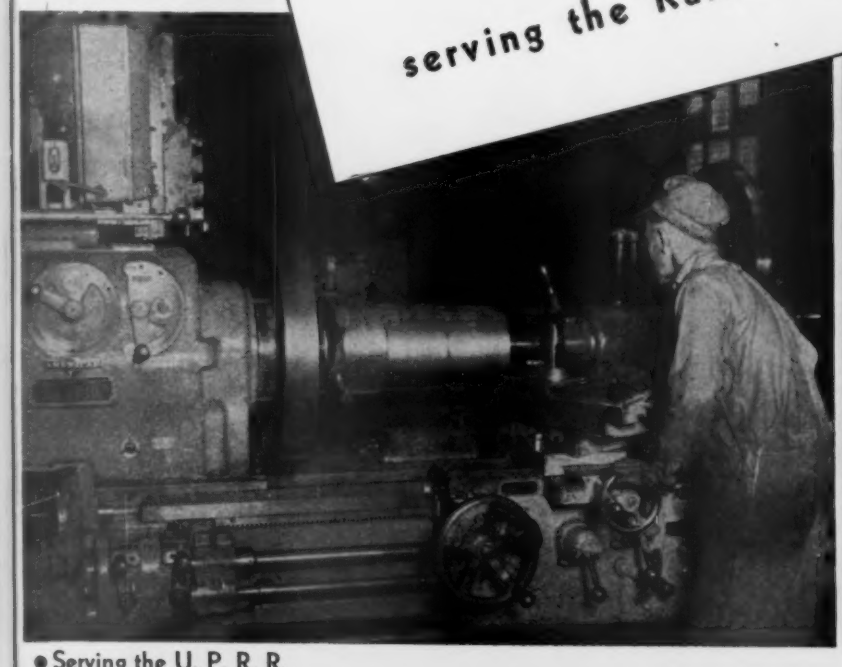
FASTEST THING IN FASTENINGS... OVER 3000 SHAPES AND SIZES

• Serving the U. P. R. R.

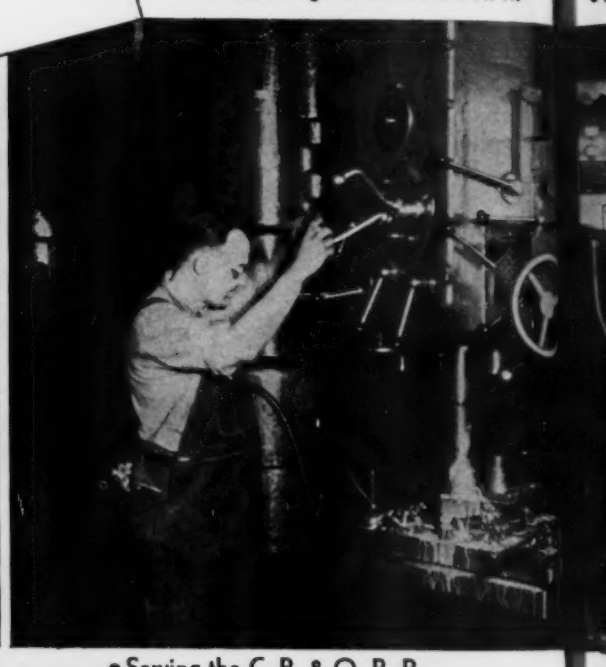


• Serving the C. & E. I. R. R.

Just a Picture Gallery showing a variety of "AMERICANS" serving the Railroads!

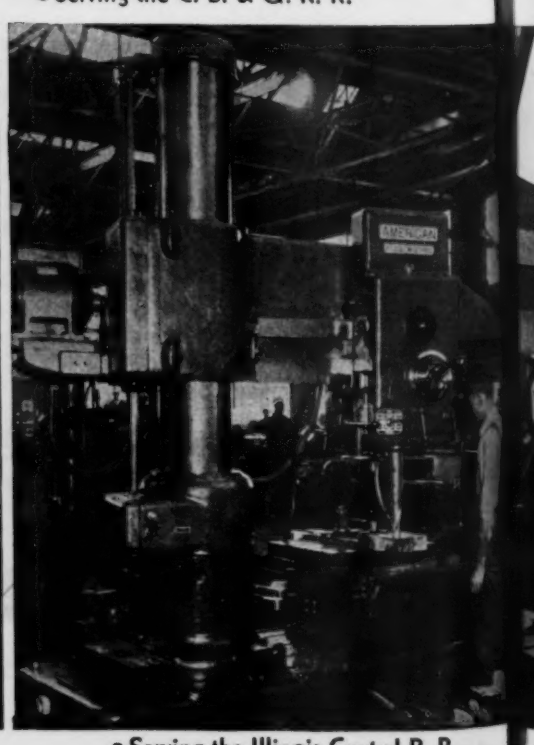


• Serving the U. P. R. R.



• Serving the C. B. & Q. R. R.

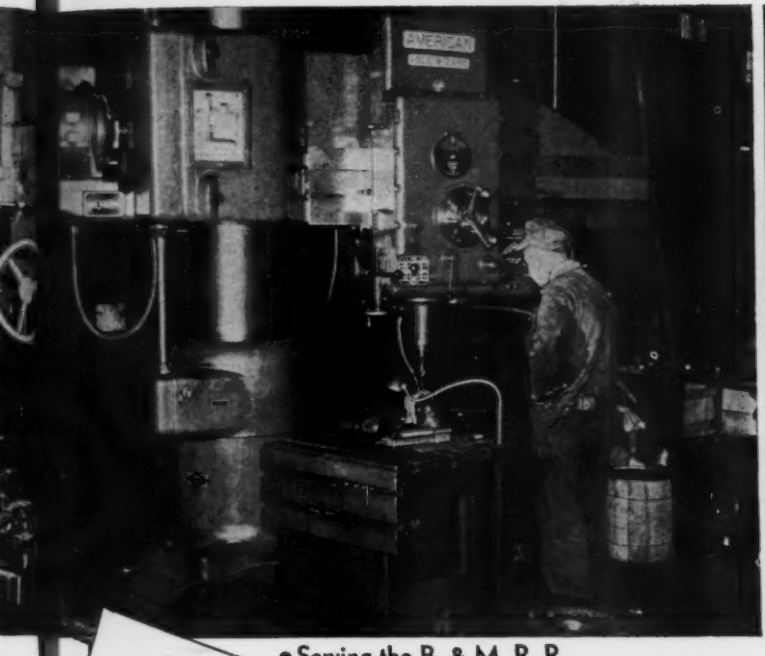
• Serving the B. & M. R. R.



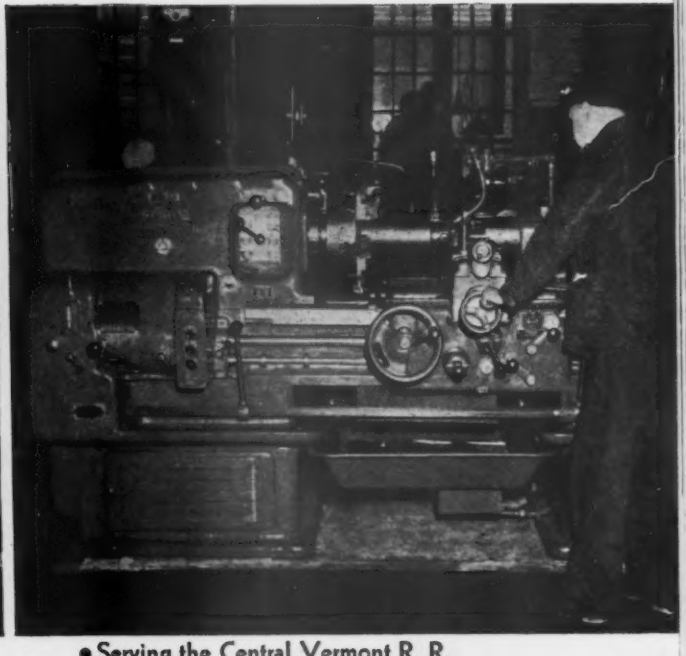
• Serving the Illinois Central R. R.

• Serving the U. P. R. R.

• Serving the N. P. R. R.

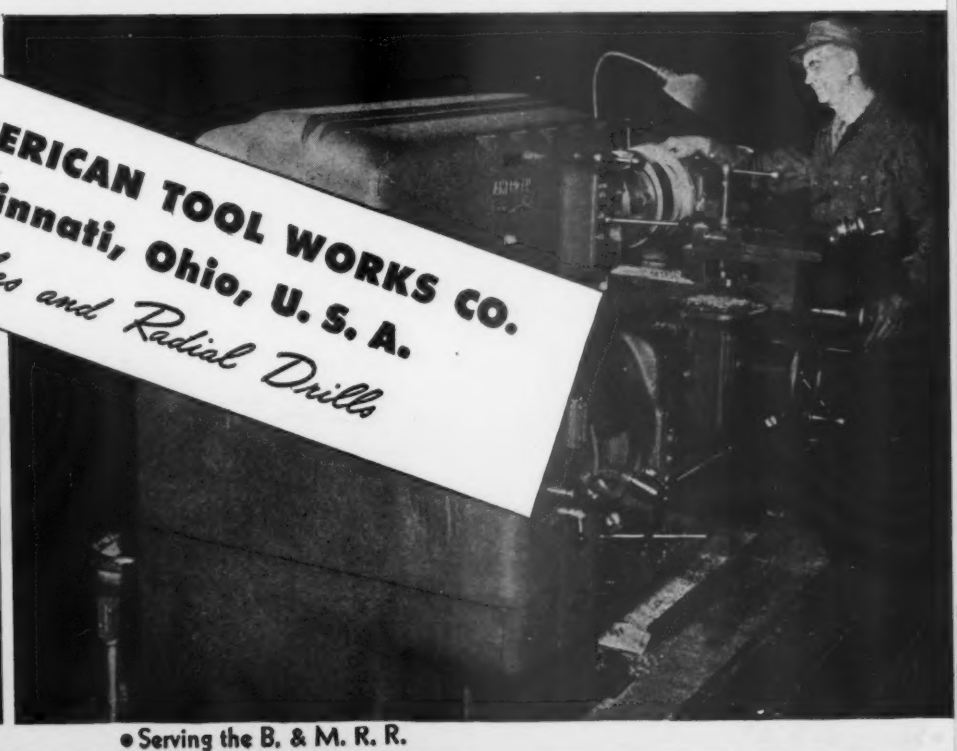


• Serving the B. & M. R. R.



• Serving the Central Vermont R. R.

• Serving the Illinois Central R. R.



• Serving the B. & M. R. R.

THE AMERICAN TOOL WORKS CO.
Cincinnati, Ohio, U. S. A.
Lathes and Radial Drills

215 INDIVIDUAL OPERATIONS MADE N

No Prior Work Layout Required—Machining Simplifie

■ Twenty-four surfaces are milled, 100 holes are drilled, 37 bored, 35 tapped, 10 reamed, 8 faced and one counterbored on a planer type G. & L. machine to complete this huge revolving frame for final assembly. All operations are performed in only three settings.

Machine scales and verniers are depended upon entirely to locate all dimensions which are held to .002" between bore centers and on pad faces. *No preliminary layout work is required.* The massive weldment is taken directly to the G. & L. machine after fabrication and is mounted on the table for machining operations.

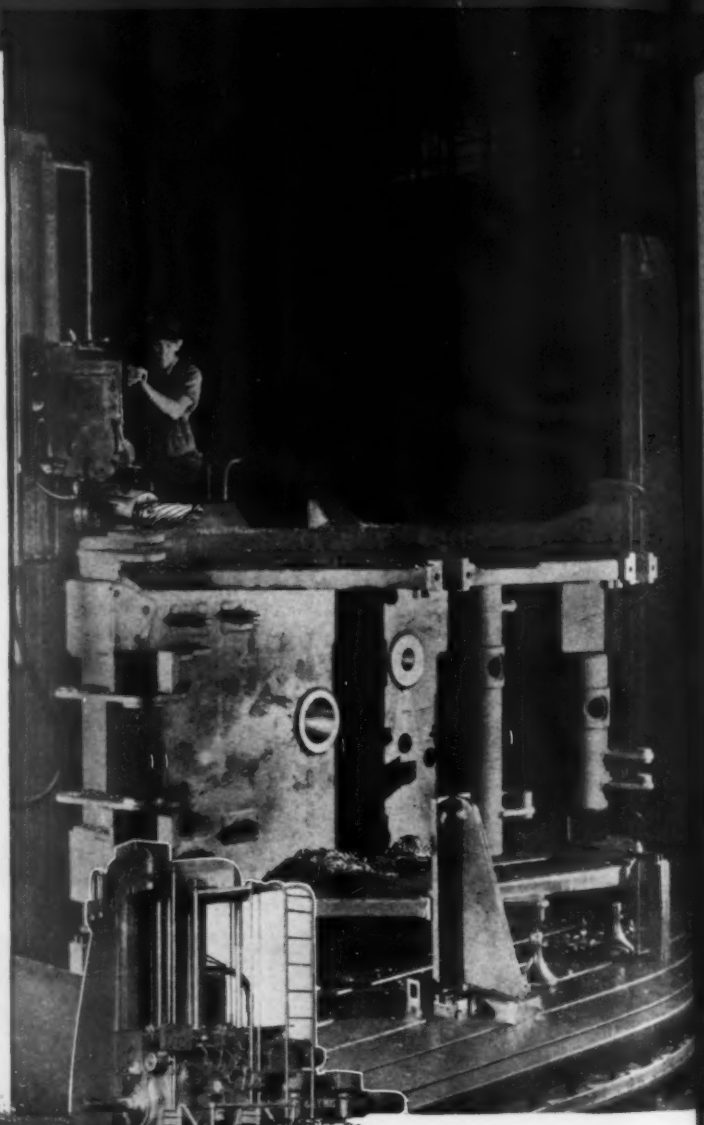
PROFILING USED TO MACHINE CIRCULAR PAD

G. & L. headstock and table feeds used in combination make it possible to profile the circular roller path without difficulty. Headstock feed is engaged simultaneously with table feed. As a result of this compound feed movement, the cutter mills the circular path of the roller pad to the required dimensions.

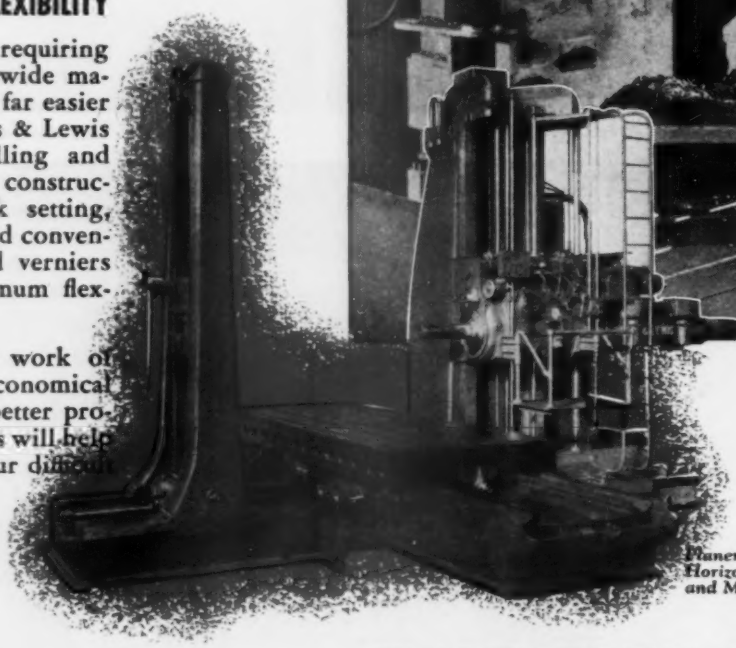
MAXIMUM MACHINE FLEXIBILITY

Large complex work requiring multiple operations and wide machining range is handled far easier and better on a Giddings & Lewis Horizontal Boring, Drilling and Milling Machine. Open construction, simplicity of work setting, accuracy of operations and conveniently located scales and verniers give this machine maximum flexibility and versatility.

If you are producing work of this kind and seek an economical and practical means to better production, G. & L. engineers will help you analyze and solve your difficult machining problems.



Giddings & Lewis 360-P Planer Type Machine with work mounted on table.



Planer Type Giddings & Lewis Horizontal Boring, Drilling and Milling Machine.

GIDDINGS & LEWIS

150 DOTY STREET

Right: G. & L. Table Type Machine

Right: G. & L. Floor Type Machine

3 SIMPLE SETTINGS OF THIS HUGE FRAME

G. & L. Scales and Verniers Permit Work Within the .002" Limits Required

COMPLETE OPERATIONS

FIRST SETTING:

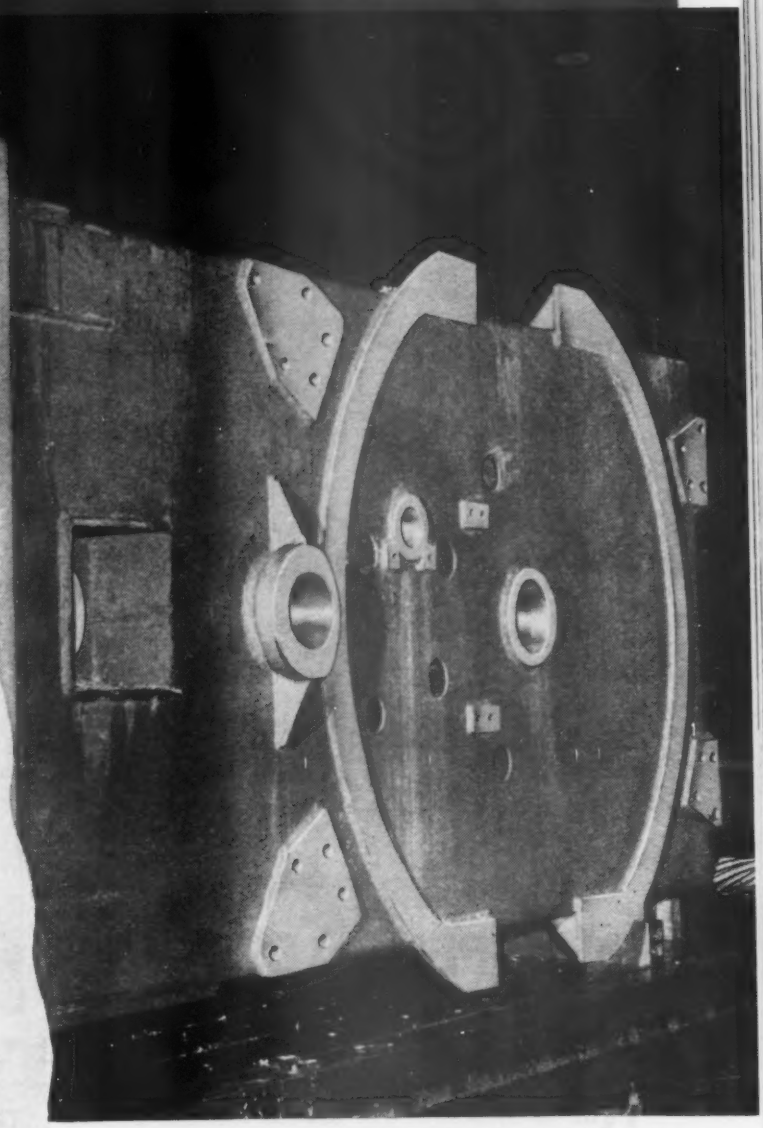
Mill twelve pads, and roller path; bore 8.125", 9.374", 4.751", 8.250", 5.500" holes; drill and tap five 3/4"—10 holes; drill ten 11/16" holes, two 5/16" holes; drill and ream one 1½" hole; drill six 15/16" holes; drill twelve 19/16" holes.

SECOND SETTING:

Mill four pads for motor base, six bearings, and pedestal stand; counterbore 5.904" diameter.

THIRD SETTING:

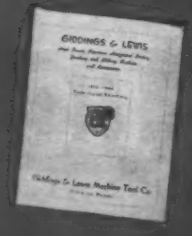
Bore and face 11.499", 7.752", 9.250", 6.125", four 7.125" holes; drill and bore four 2 25/32" holes, two 2 1/32" holes, six 1.752" holes, four 2.002" holes; drill and ream 1.499" hole; drill, bore and ream two 2.450" holes, six 2.937" holes; drill and tap thirty 5/8"—11 holes; and drill nine 23/32" holes.



Revolving Top Frame for Excavator in first work position.

FREE Field Production Facts

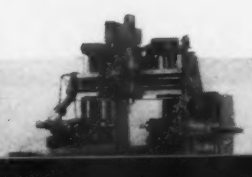
will help you solve difficult machining problems. Write today for your copy of Trade Journal Advertising RM150, covering advanced G. & L. machining methods. Please indicate your business connection.



MACHINE TOOL CO.

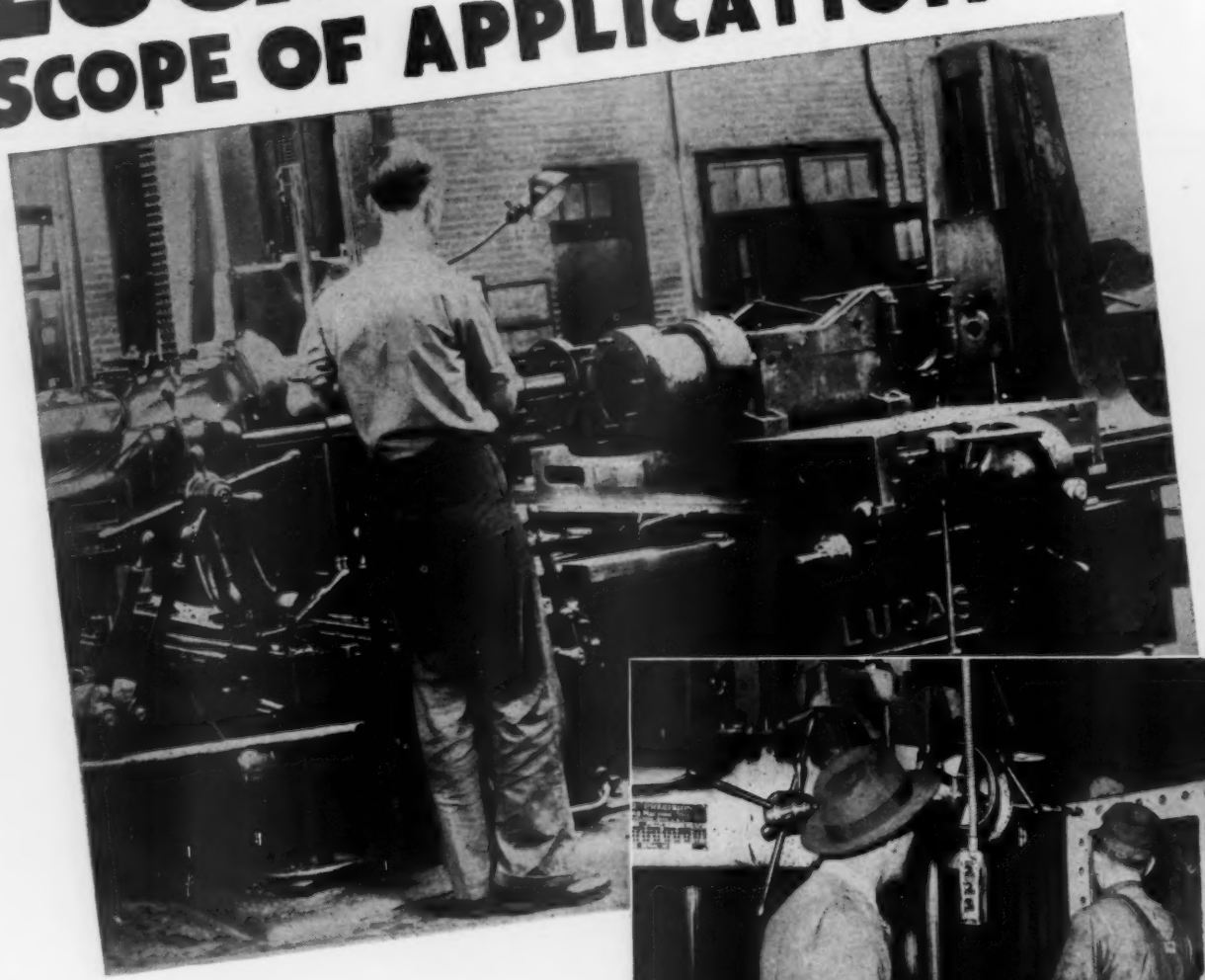
FOND DU LAC, WIS.

Left: G. & L. Planer Type Machine



Left: G. & L. Multiple

LUCAS "PRECISION" SCOPE OF APPLICATION



INDISPENSABLE IN A LOCOMOTIVE SHOP . .

DUE to its design, it is obvious that the LUCAS Horizontal Boring, Drilling and Milling machine is a general purpose tool. Its cost-saving scope of application covers so many jobs that many railroad shop foremen claim it is indispensable.

The biggest savings effected are on large and cumbersome parts that require several operations which are difficult to handle on any other unit, but simple to set up and machine on a Lucas.

These parts include stokers, feedwater heaters, power reverse gears, coal pushers, dry pipes, one-piece truck frames and many other components.

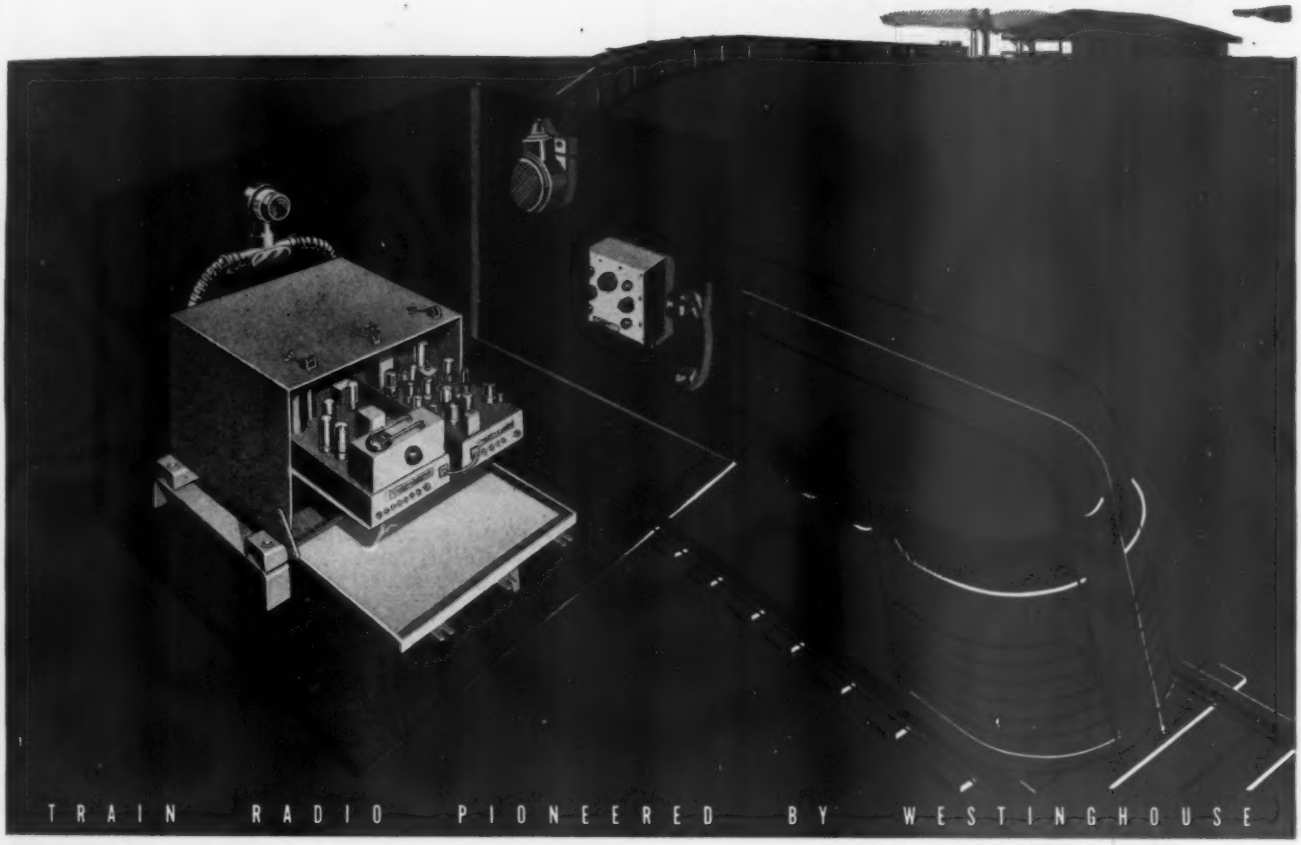
Upper illustration shows a LUCAS boring a stoker engine cylinder — the cylinders did not have to be removed from the bed. Bottom view shows a recent installation drilling holes in a heavy Mallet type bumper and supporting bracket. Yes! You can always keep a LUCAS saving money in your shop.

LUCAS MACHINE TOOL CO.
CLEVELAND, OHIO

Westinghouse builds

Train radio for the Railroads

. . . since 1925



Westinghouse's vast experience in railroad electrical equipment is now applied to building space radios designed *specifically for railroad* operation.

Westinghouse engineers have proved their ability to design sturdy equipment to meet the toughest handling and severest weather conditions.

This new transportation development attains reliable communication between wayside station and train . . . train to train . . . engineer to caboose.

The unmatched experience of Westinghouse in Train Radio since 1925 is a logical reason for consulting Westinghouse to aid in your communication problems. Write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-95108

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

FOR OVER 60 YEARS THE BEST KNOWN NAME IN RAILROAD ELECTRICAL EQUIPMENT

OTISCOLOY PLATES

AND

OTISCOLOY SHAPES

Today's trend toward maximum structural strength with minimum structural weight brings into prominence Otiscoloy, J & L's lightweight steel of high tensile strength that affords long wear and service. Otiscoloy is adaptable to hot and cold working, is as readily weldable as low carbon steels, resists corrosion and abrasion, is available in Plates, Sheets, Light Weight Channels, Junior Beams, Junior Tees, Angles, Bars and Jal-Tread Floor Plate.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PENNSYLVANIA

DOW CORNING

SILICONES increase permissible operating temperatures by more than 100°C.

Today many accepted engineering limitations are being swept away by revolutionary new Dow Corning silicone materials. Designers are making major product improvements—coupled with important economies—never before possible.

Here's a specific example. Dow Corning varnishes and resins—because of their unique resistance to high temperatures—make it possible to redesign or rewind electrical equipment for increased horsepower output per unit weight. At the same time they greatly prolong equipment life under adverse operating conditions and reduce overload failures and fire hazards.

The recent development of DC 996, a Silicone Varnish which cures at 300°F., enables any electrical maintenance or rewind shop to secure the greater operating economies of Silicone Insulation.

In other industries Silicone materials also make possible operations which were previously impossible or very expensive. Consult Dow Corning for particulars.

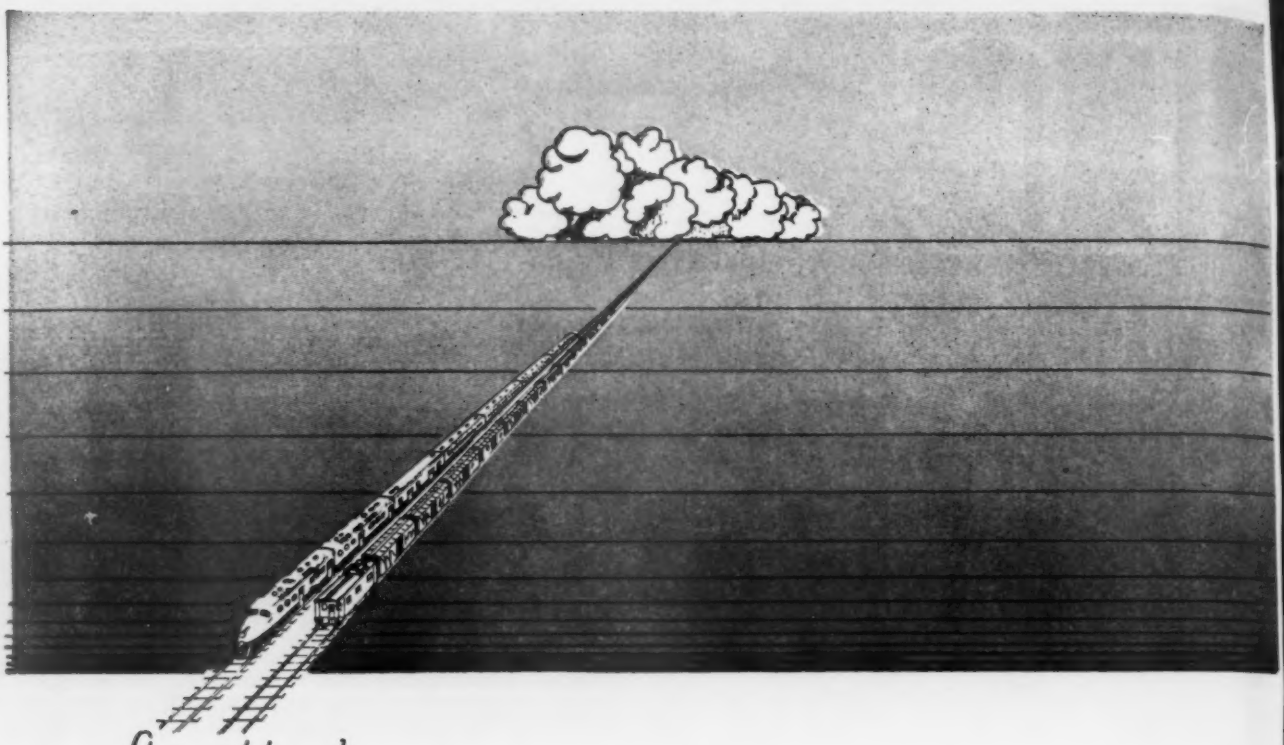
IN THE ELECTRICAL INDUSTRY, FOR EXAMPLE

This test motor wound with Silicone Insulation has been alternately saturated with moisture and operated at 310°C. (590°F.) by resistance, for a total of 2,000 hours with no sign of failure. Silicone Insulation means reliable and continuous operation under most adverse conditions.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
NEW YORK OFFICE: EMPIRE STATE BUILDING

Dow Corning

FIRST IN SILICONES



Sky High

The latest development in Hydraulic Safety Jacks with fully patented "Quick Contact" for all lifting, hoisting, pushing and pulling jobs in the maintenance of locomotives and cars.

Sky High Hydraulic Jacks and tools embody the best features of modern hydraulic principles especially adapted to Railroad Mechanical Department Tools.

***Sky High* will include:**

- **Hydraulic Draft Gear Tools—for installing and removing draft gear in passenger and freight cars.**
- **Hydraulic Hoist for Heavy Parts—to install or remove quickly, heavy parts and fixtures beneath locomotives and cars.**
- **Portable Rams, Operated by Separate Pumps—for use in close quarters, equalizer spring jobs, car straightening, etc.**
- **Hydraulic "Quick Contact" Safety Jacks—for locomotives, cars, etc.**
- **Hydraulic "Quick Contact" Binder Pushers—for rapid and safe installations of Locomotive Binders, etc.**
- **All Actuating Parts Enclosed—affording longer life through protection of vital parts against foreign matter and damage in use and handling.**

Years of experience in design, engineering, and production of many hydraulic units for installation in aircraft as well as for their service and maintenance is your assurance that United Aircraft Products, Inc. will make available to you exceptional hydraulic products and provide engineering counsel in the helpful solution of your problems. Distribution of Sky High Hydraulic Products is "just around the corner." Watch for early announcement.

UNITED AIRCRAFT PRODUCTS, INC.

RAILROAD TOOL MFG. DIVISION

SKY HIGH

2929 SANTA FE AVENUE
LOS ANGELES 11, CALIFORNIA

GENERAL OFFICES: DAYTON, OHIO

UAP

The Problem: SMALL LOT RUNS

The Answer: WARNER & SWASEYS!

RIGHT now, a great many plants are finding production demands changing from long to short runs, with profitable operation more and more dependent on ability to shift equipment quickly from one job to another.

Five factors enter into profitable small run production:

1. Speed and ease of changeover—to keep set-up time low.
2. Flexibility in tooling—to cover the widest range of operations possible with one set-up.
3. Dependability—to hold close tolerances without time-wasting trouble-shooting.
4. Ease of operation—to speed job through.
5. Low maintenance costs—to cut overhead that must be charged against each job.

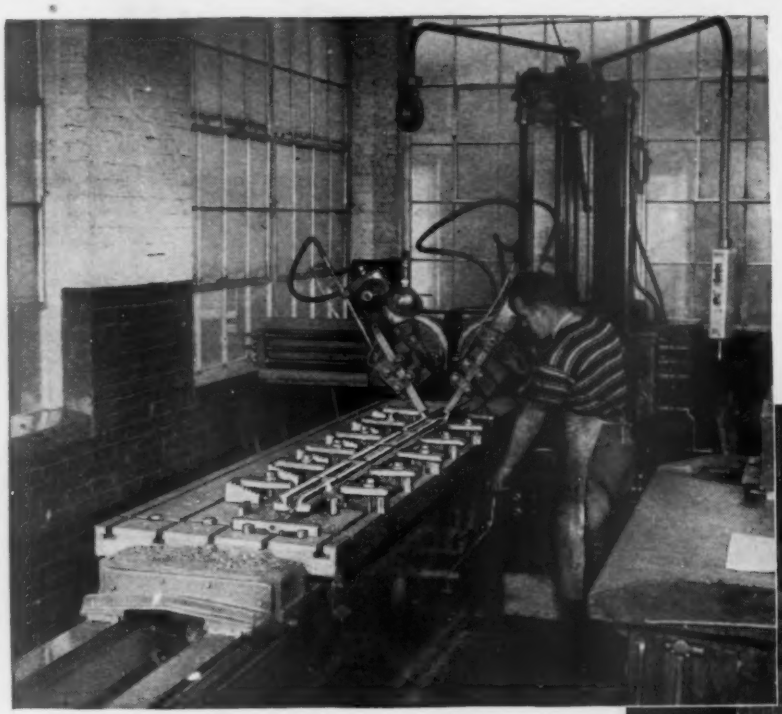
If you'll check up on your own experience with Warner & Swaseys—or the experiences of others—you'll find that they prove to be at or near the head of the list on every one of these five counts!

Why not let a Warner & Swasey Field Engineer show you how the quick adaptability of Warner & Swaseys provides the answer to the problem of maintaining profits in the days ahead. When you plan your equipment investment, look beyond the immediate job in hand—to years of low-cost profitable operation with multi-purpose Warner & Swaseys.

YOU CAN MACHINE IT BETTER, FASTER, FOR LESS . . . WITH A WARNER & SWASEY

TURRET LATHES, SADDLE AND RAM TYPES — CHUCKING AND BAR TOOLS — PRECISION TAPPING AND THREADING MACHINES

WARNER & SWASEY
Machine Tools
Cleveland



Hy-Draulic

4518

Light Bite

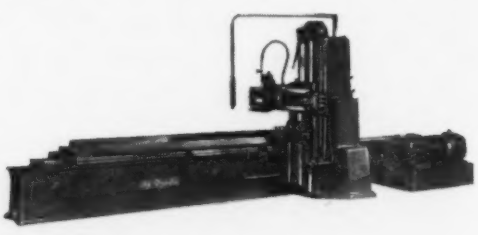
or a

Mouthful

Hy-Draulic Shaper-Planer Work Is ACCURATE • FAST • EASY

Handy, powerful, durable, the Hy-Draulic Shaper-Planer is particularly effective on pieces that are too big for large shapers yet too small for economical production on planers. Accurate, fast, easy to operate. It handles such a wide variety of work, light, medium and heavy, that it quickly becomes one of your most profitable investments. Investigate the advantages of hydraulic drive and feeds in the Rockford Hy-Draulic Shaper-Planer. Write, today, for Bulletin 1926.

- Above, left .... A 120" stroke Hy-Draulic Shaper-Planer, planing dovetails on cast-iron slides. Extra crossrail head reduces planing time.
- Above, right .... Same Shaper-Planer roughing a gang of cast steel steering gear parts. Note crossrail head and side head are both working on intermittent cuts.

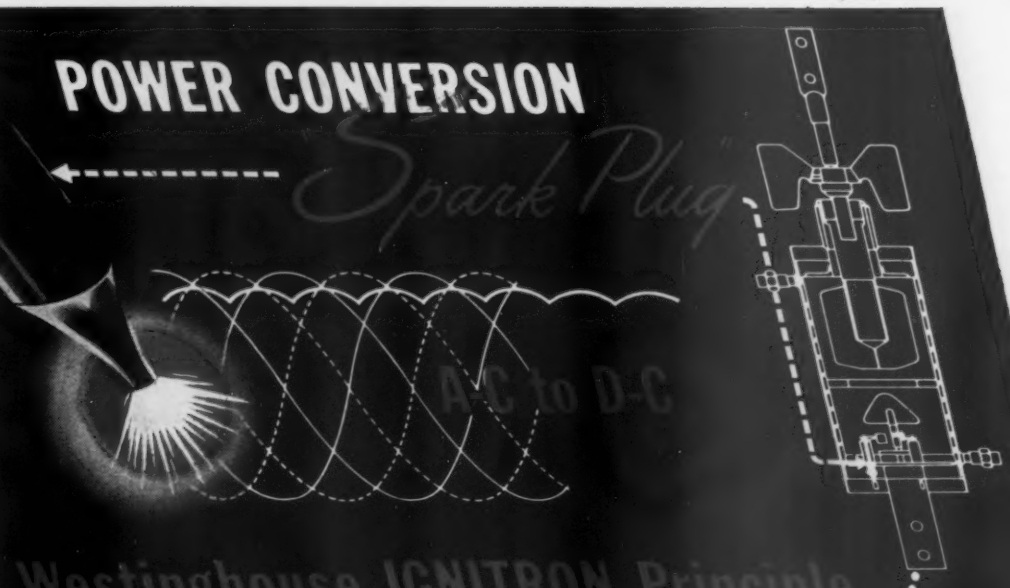


ROCKFORD HY-DRAULIC SHAPER-PLANERS
Available in stroke-lengths of 42", 66", 90", 120" and 144". Hy-Draulic Shaper-Planer speeds and feeds are infinitely adjustable in specified ranges. Economical standard constant speed electric motor drives hydraulic unit.

ROCKFORD MACHINE TOOL CO., ROCKFORD, ILLINOIS

POWER CONVERSION

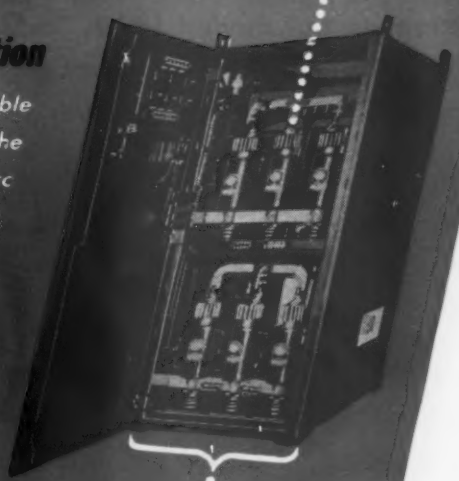
Spark Plug



Westinghouse IGNITRON Principle

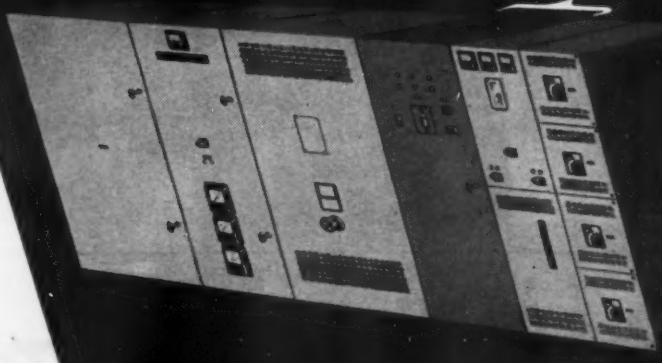
Heart of the IGNITRON Unit Substation

The Westinghouse Ignitron Principle provides a reliable method of starting an arc in a few micro-seconds, at the beginning of each conducting period and permits the arc to extinguish when the anode is not conducting current. This principle permits use of minimum shielding, thereby lowering arc losses. These inherently low losses provide remarkably high efficiency at low loads, as well as under heavy load conditions. The ignitron rectifier consists of the correct number tubes, for the required KW output. Each tube is complete with its anode, cathode and ignitors and is evacuated and permanently sealed at the factory



ASSURES CONTINUOUS SMOOTH FLOW OF CURRENT

CONSIDER ALL ADVANTAGES OF POWER CONVERSION AT ITS BEST



Consult Westinghouse

Get all the facts of this Ideal Power Unit. Call at your nearest Westinghouse office or write for B-3646-"IGNITRON UNIT SUB-STATION"—Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

Westinghouse *Electronics at Work*

J-10299

you wouldn't

lift a 500 pound load with a 100 pound capacity rope

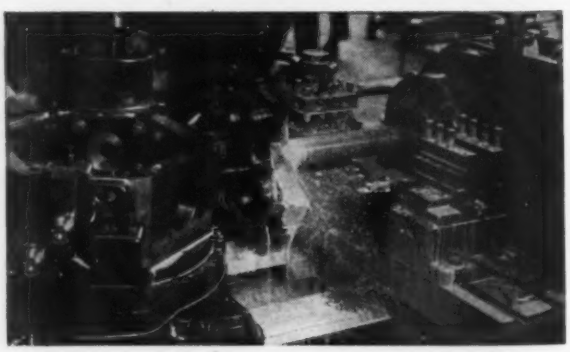
It is just as foolish to put carbide cutting tools on an out-moded lathe. Carbide tools have increased horsepower requirements as much as 300 per cent.

Modern Jones & Lamson Lathes are designed specifically to carry this extra load, and more. They have the power, they have the rigidity, they are easy to operate.

Now is the time to check your equipment. Plan now to scrap obsolete machines and replace them with good War Surplus machines or new machines. Our engineers will be glad to assist you.

What HORSEPOWER Are You Using?

This cut, on 2-inch bar stock, requires 300 per cent more horsepower with a carbide tipped tool than with a high speed steel tool, and Carbide halves the cutting time.



Engineered to "Carry the Load" for Most Productive Operation With Carbide Cutting Tools

JONES & LAMSON
MACHINE COMPANY
Springfield, Vermont, U.S.A.

Turret Lathes

Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

...with **GIANT SIZE** dates

Each numeral 1¾" high—that's the feature of this beautiful new six-color POST 1946 Calendar—overall size 12"x20". Each date of the week is designed to be legible from any spot in the drafting room. The entire current month with ultimate and proximate months appear on each weekly page. The calendar is in full, brilliant color and includes a section devoted to significant drafting room data, covering charts on wire and sheet metal gages, screw threads, bolt heads, pipe and pipe fittings, gears, metric equivalent, and complete twelve-month calendar.

The Frederick Post Company
3650 AVONDALE AVE • CHICAGO 18, ILLINOIS
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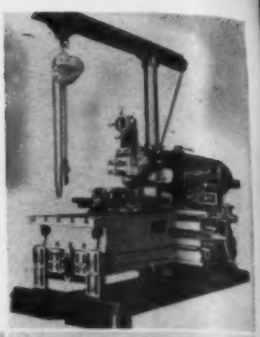
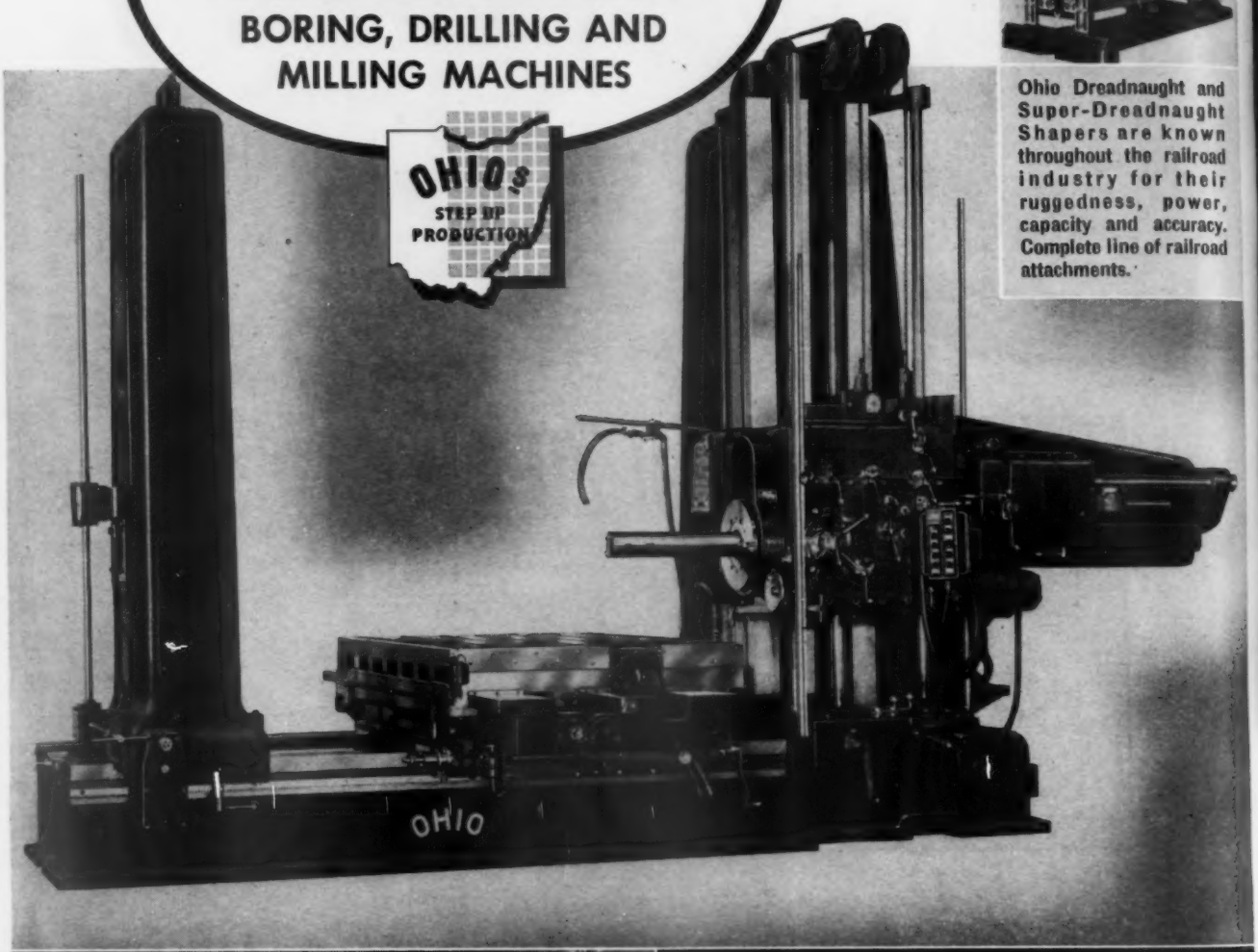
OHIO HORIZONTAL

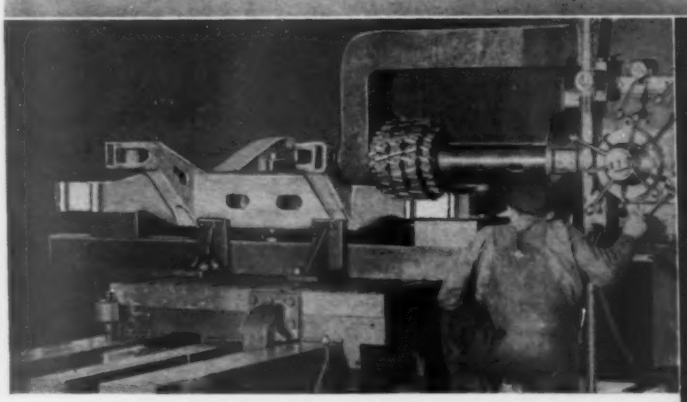
BORING, DRILLING AND MILLING MACHINES

OHIO is STEP UP PRODUCTION



Ohio Dreadnaught and Super-Dreadnaught Shapers are known throughout the railroad industry for their ruggedness, power, capacity and accuracy. Complete line of railroad attachments.





Milling high tensile cast steel unit bolster for a Buckeye six-wheel locomotive tender truck on an OHIO horizontal.

Ohio Horizontal Boring, Drilling and Milling Machines, with their power, precision, convenience and safety, have helped make new records in the railroad field and elsewhere. They are available in 5" and 6" spindle sizes in both table and floor models. No reconversion delays; we are ready to serve you promptly. Write for Bulletin 1000.

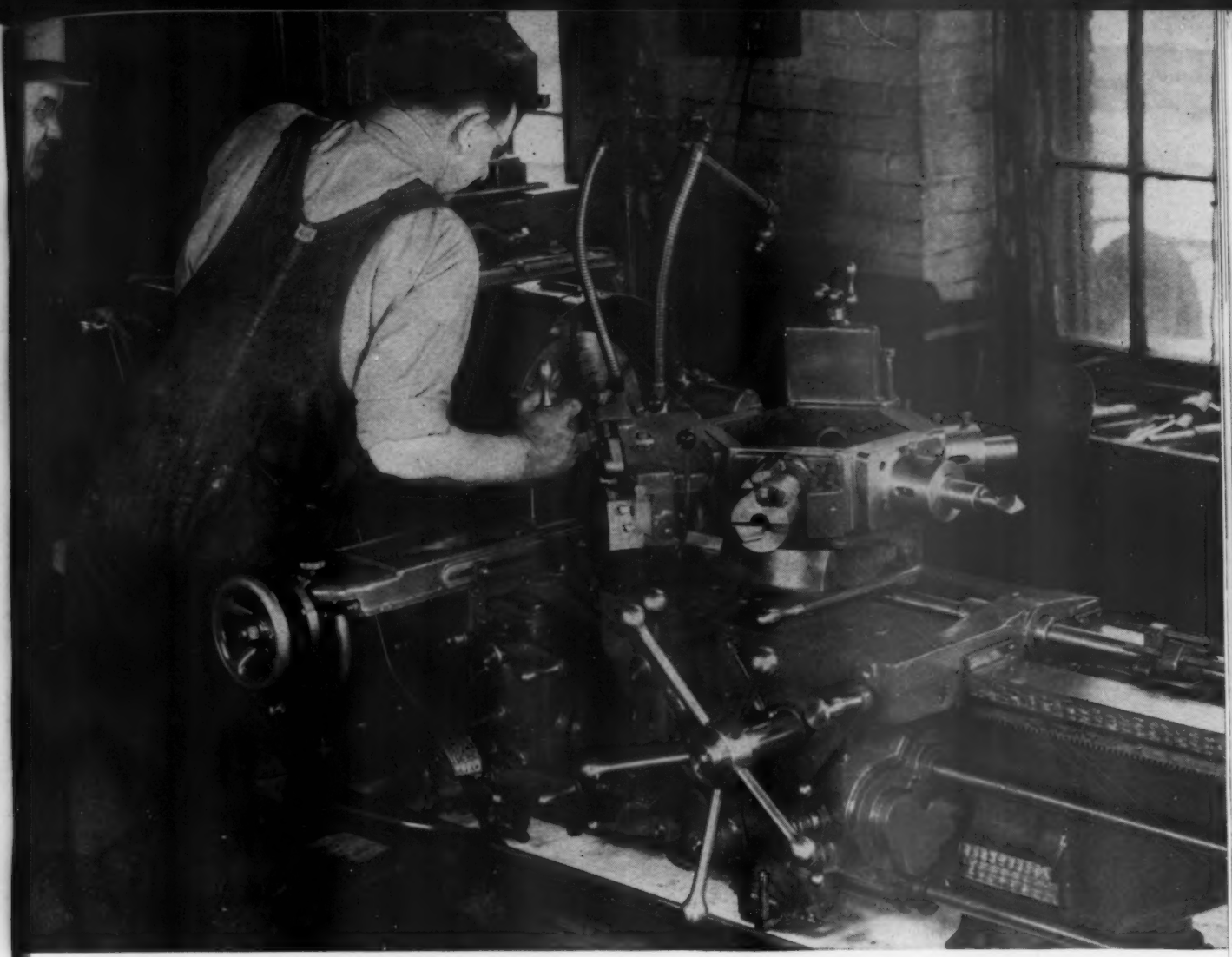
THE OHIO MACHINE TOOL COMPANY

Serving the Metal-Working Industry Since 1887

KENTON, OHIO

OHIO DREADNAUGHT

HORIZONTAL BORING, DRILLING AND MILLING MACHINES • SHAPERS • PLANERS



IN RAILROAD TOOL ROOMS, TOO

Gisholt Turret Lathes Pay Out

In meeting wartime emergencies, railroad shops all over the country have proved the value of Gisholt Turret Lathes—building stocks of standard replacement parts—saving time and money to keep the rolling stock rolling.

But here's another example—in the tool room of a locomotive boiler shop. Here Gisholt Turret Lathes are used to manufacture a variety of boilermaker tools and flue cleaner parts. Producing them even in such small quantities as 12 per lot, this Gisholt 1 L High-Production Turret Lathe proved itself both practical and profitable—doing more work than two other type lathes, and at lower cost.

Gisholt engineers, familiar with railroad shop work, will gladly discuss your particular problems with you.

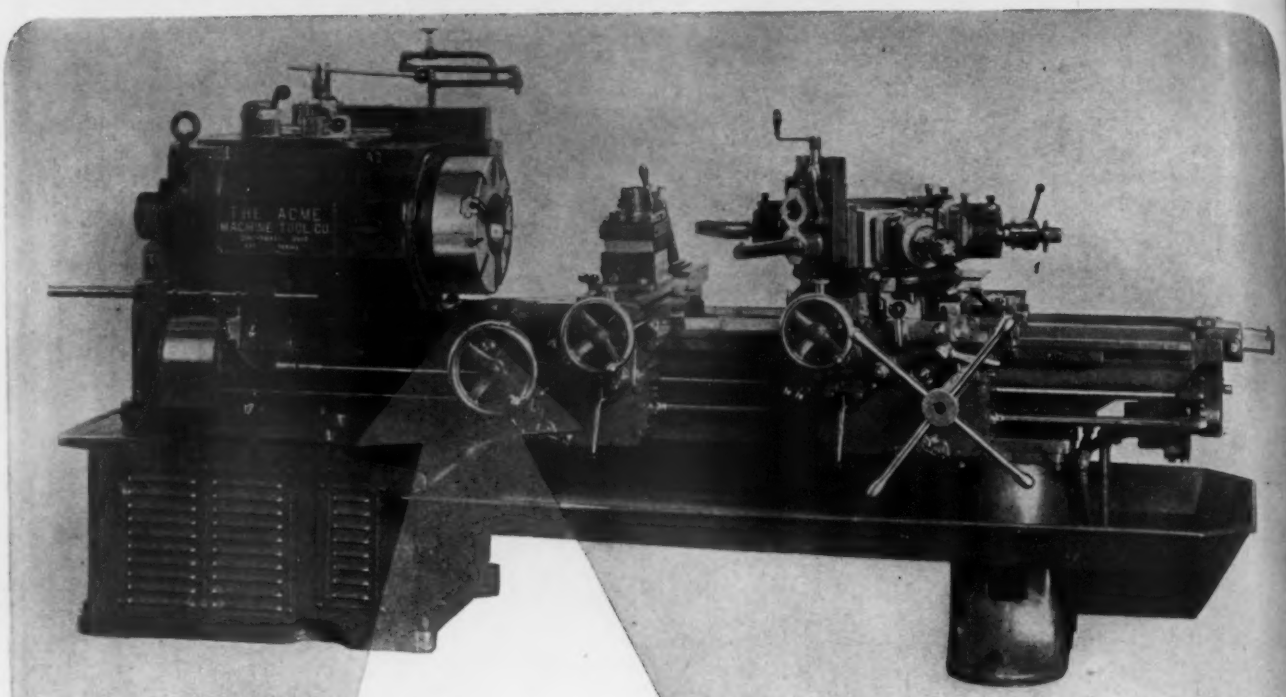
Boilermaker tools, flue cleaner parts and other miscellaneous railroad parts such as these are produced quickly, accurately and at low cost, thanks to Gisholt's easy tool set-up and simple operation. Complete information on request.

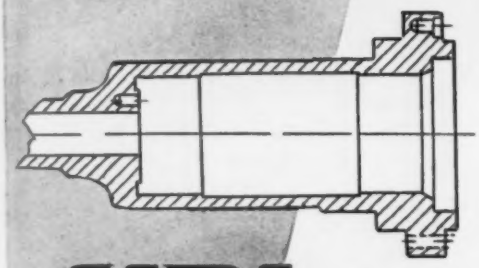
GISHOLT MACHINE COMPANY

1293 East Washington Avenue • Madison 3, Wisconsin

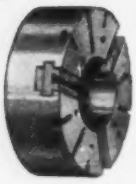
Look Ahead . . . Keep Ahead . . . With Gisholt Improvements in Metal Turning

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES





ACME *gives greater spindle capacity*



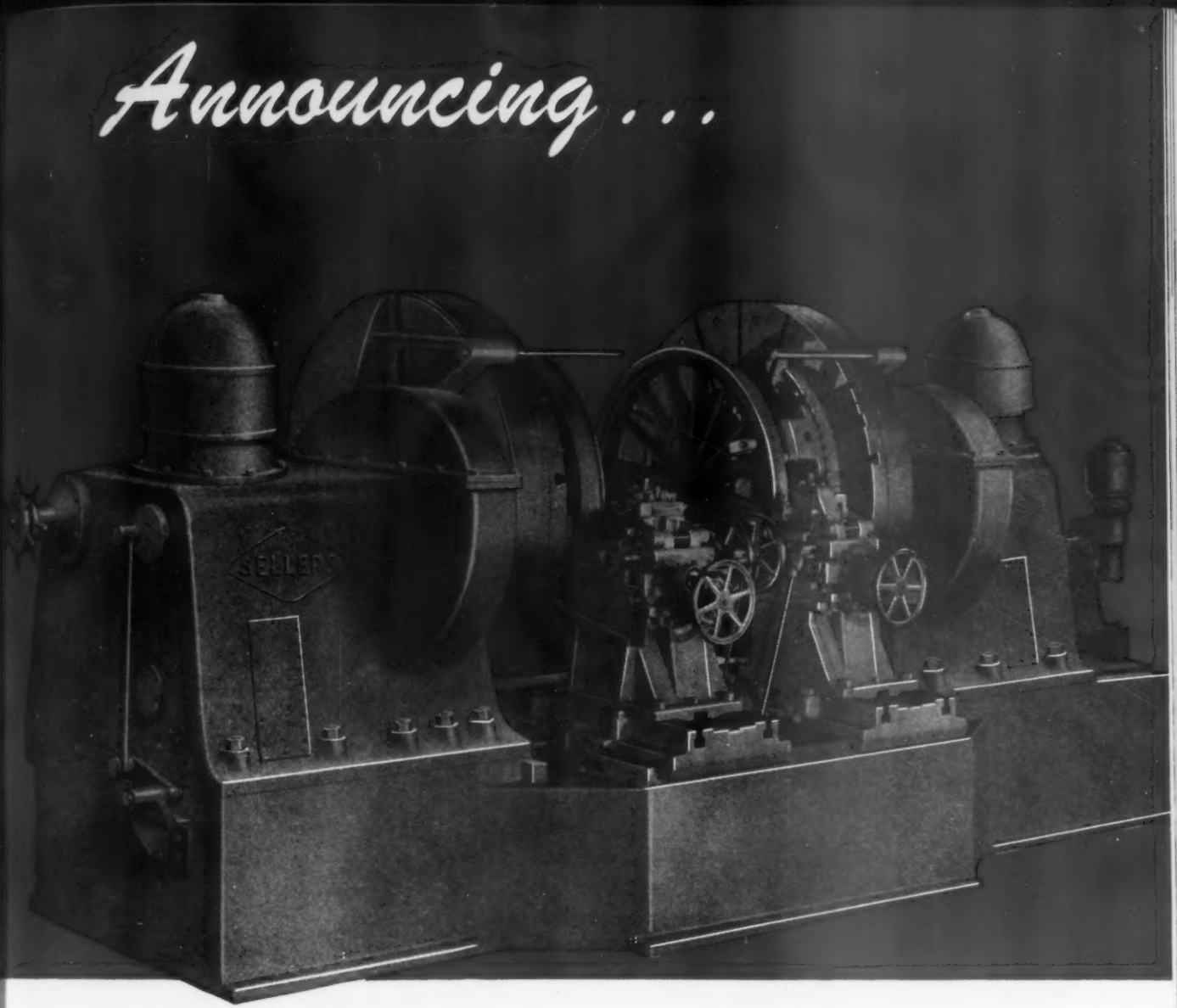
Now you can profit from increased versatility in this deep throat Acme Universal Turret Lathe. Designed especially to machine those forgings, tubings and similar large diameter pieces requiring a deeper throat and greater chuck capacity, this Acme Turret Lathe is a welcome addition to your plant.

This machine, likewise, includes a triple roller bearing spindle and brake, hardened steel vees, extended square turret cross slide and rear tool post, and rapid power traverse for longitudinal movement of the hexagon turret. All moving parts run in an oil bath.

We'll be pleased to furnish you specific information at your request.

The ACME MACHINE TOOL Co.
CINCINNATI 32, OHIO

Announcing . . .



THE SELLERS 90" DUAL DRIVE ENGINE DRIVING WHEEL LATHE

75 YEARS AGO (that's before your time) America's infant railroads and locomotive builders depended on Sellers lathes to true their engine driving wheels. These tools, though crude and slow, were the best available, and played no small part in the rapid growth of the world's greatest transportation system.

Today Sellers presents a Dual Motor Engine Driving Wheel Lathe of such accuracy and ease of operation that it has no counterpart in performance. Details of its design, capacity and operational features will gladly be sent you on request.

Wm. SELLERS & COMPANY

16th & HAMILTON STREETS • PHILADELPHIA

SELLERS PRECISION TOOLS SINCE 1848

Duff-Norton

Air Motor Operated

Power Jacks

✓Speed Car Repairs

✓Save Man-hours

Results of long shop service definitely prove the advantages of Duff-Norton Air Motor Operated Power Jacks, bearing out the claims for speeded-up repair work and man-hours saved.

The complete line of Duff-Norton Air Motor Jacks includes 5 types in capacities from 20 to 100 tons for every type of roundhouse and car shop work. Write for descriptive literature.

HERE'S WHAT THE EDITORS OF Railway Mechanical Engineer HAVE TO SAY...

Jack-Handle Days...

According to the best estimates of time-study men on one of our major railroad systems, two 50-ton air-operated jacks installed at an average freight car repair point today will have paid for themselves by savings in labor costs alone within 15 months.

That's Right! Paid for themselves within 15 months!

Even more important are the man-hours saved for use on other work and the increased speed of car release from repair points. Experience has shown that about 800 hours of mechanics' or helpers' time has been saved through such an installation during the course of a single year.

800 hours saved!

At an exceptionally busy shop point such an installation, made in 1937, was paid for within the first four months after the jacks were delivered.

Within the first 4 months

Various committees of the Car Department Officers' Association and other groups have urged consistently that more attention be paid in the expenditure of mechanical department funds to the needs of car repair points. Whether the men on the locomotive side have been more articulate in expressing their needs isn't clear but generally it appears that a new shaper for the backshop or a lathe for an enginehouse is more likely to be approved than two jacks for the car yard. Their relative cost is small, the rate of amortization on the investment high but at all too many points the jack-handle rather than the air-line lifts cars.

What is true of car jacks is true of many other items of equipment in use at car repair points. A thorough study on any system of the possibilities of employing modern tools and devices would enable car department officers to approach management intelligently with requests for appropriations. The accumulated labor cost and car-release delay time represented by jack-handle days should convince even a stubborn management in times much harder financially than the present.

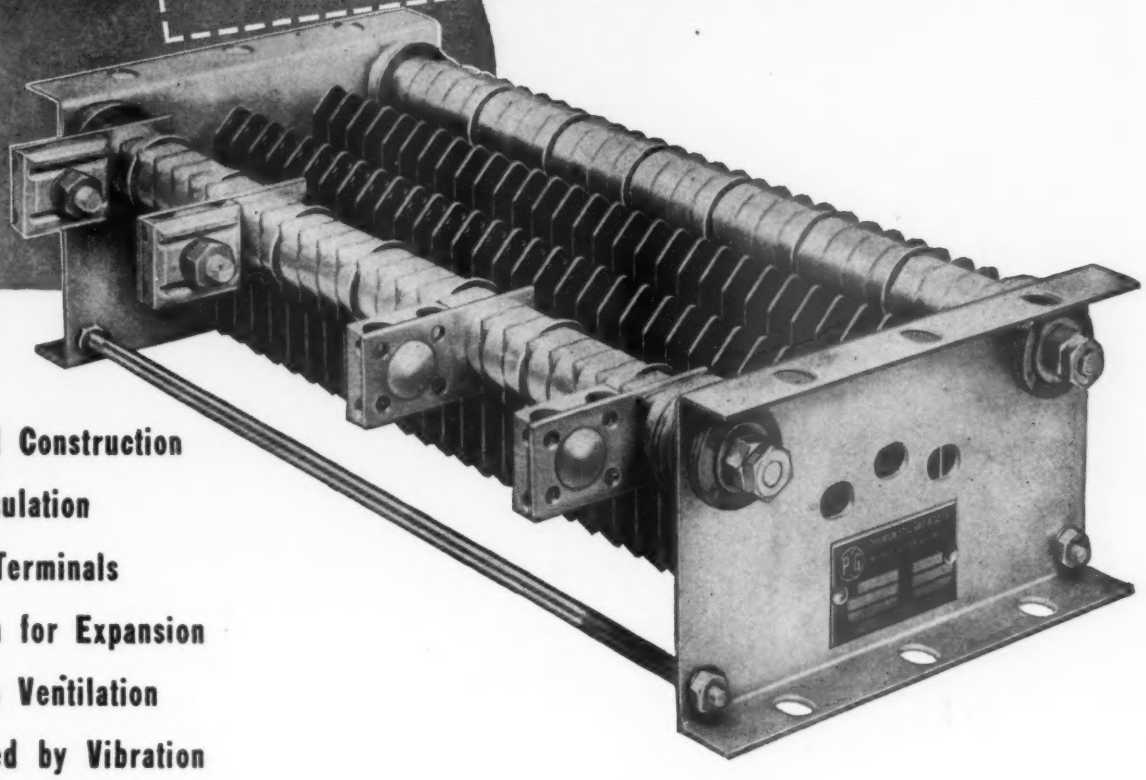
"An editorial appearing in a recent issue of Railway Mechanical Engineer."

THE DUFF-NORTON MANUFACTURING CO., Pittsburgh, Pennsylvania

CANADIAN PLANT: COATICOOK, QUE. • REPRESENTATIVES IN PRINCIPAL CITIES

POST-GLOVER

P-G... *Nonbreakable* STEEL GRID *Resistors*



All Steel Construction
Mica Insulation
Rugged Terminals
Provision for Expansion
Adequate Ventilation
Unaffected by Vibration
Moisture Resistant
Corrosion Protected

These Post-Glover Standard Resistor Units will increase production equipment availability thru reduction in motor maintenance and machine hours lost from electrical failures. P-G Steel Grid Resistors are rugged because they are built of steel and mica. Add to this, sound resistance values with ample capacities and failures due to resistor trouble cease to exist. Specify P-G for your next application, especially, if your operating conditions are severe.

BULLETIN No. 500 IS AVAILABLE FOR DETAILED RESISTOR DATA

P-G

The Nonbreakable Steel Grid Resistor

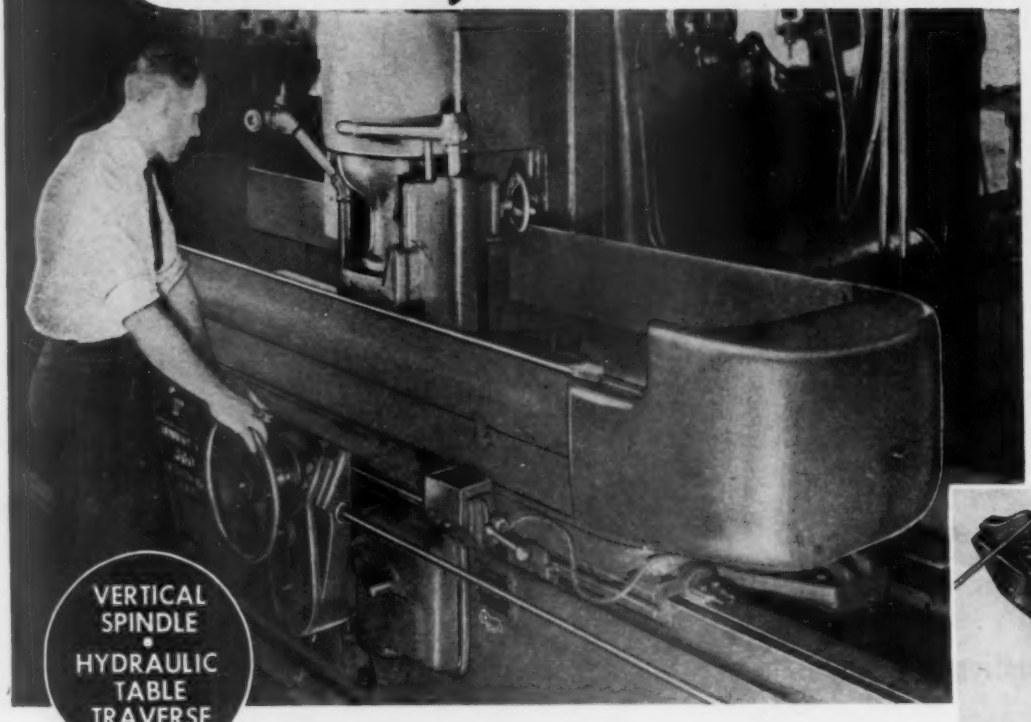
THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

MEET TOOLROOM TOLERANCES

On High Production Runs



VERTICAL SPINDLE • HYDRAULIC TABLE TRAVERSE

The Wm. Schollhorn Co., New Haven, Conn., uses this Hanchett 300 to finish-grind jaw members and other parts for Bernard Pliers. Also handles work up to 12" wide, 36" long and 10" high.

Bernard Pliers are produced in volume, sell at low cost. Grinding parts on the 300 helps keep production costs at a minimum.

with the HANCHETT "300" Surface Grinder!...

Here's a typical problem solved with a Hanchett 300 Surface Grinder:

The Wm. Schollhorn Co. manufactures Bernard Parallel-Action Pliers — mass-produced hand tools that have many replaceable and interchangeable parts. For this reason stock must be removed within extremely close tolerances — yet the finishing cost per unit kept very low.

That's why the Hanchett 300 got the job. Its long, rectangular magnetic chuck firmly grips a large number of small parts — no fixtures needed. Since the 300 is semi-automatic, operator merely loads chuck, starts machine and unloads finished pieces — a fast, simple operation. And the 300 works easily to tolerances of .0002 — assured accuracy on every piece!

USE THE 300 FOR GRINDING
Dies... Knives... File Blanks
Parts for Locomotives, Automobiles, Aircraft and Home Appliances.

The Hanchett 300 is built in several sizes, for varying requirements. And remember—Hanchett manufactures *all* types of Surface Grinders. If your problem is Grinding, consult Hanchett. You can be sure of unbiased information at no obligation. Write today for Bulletin

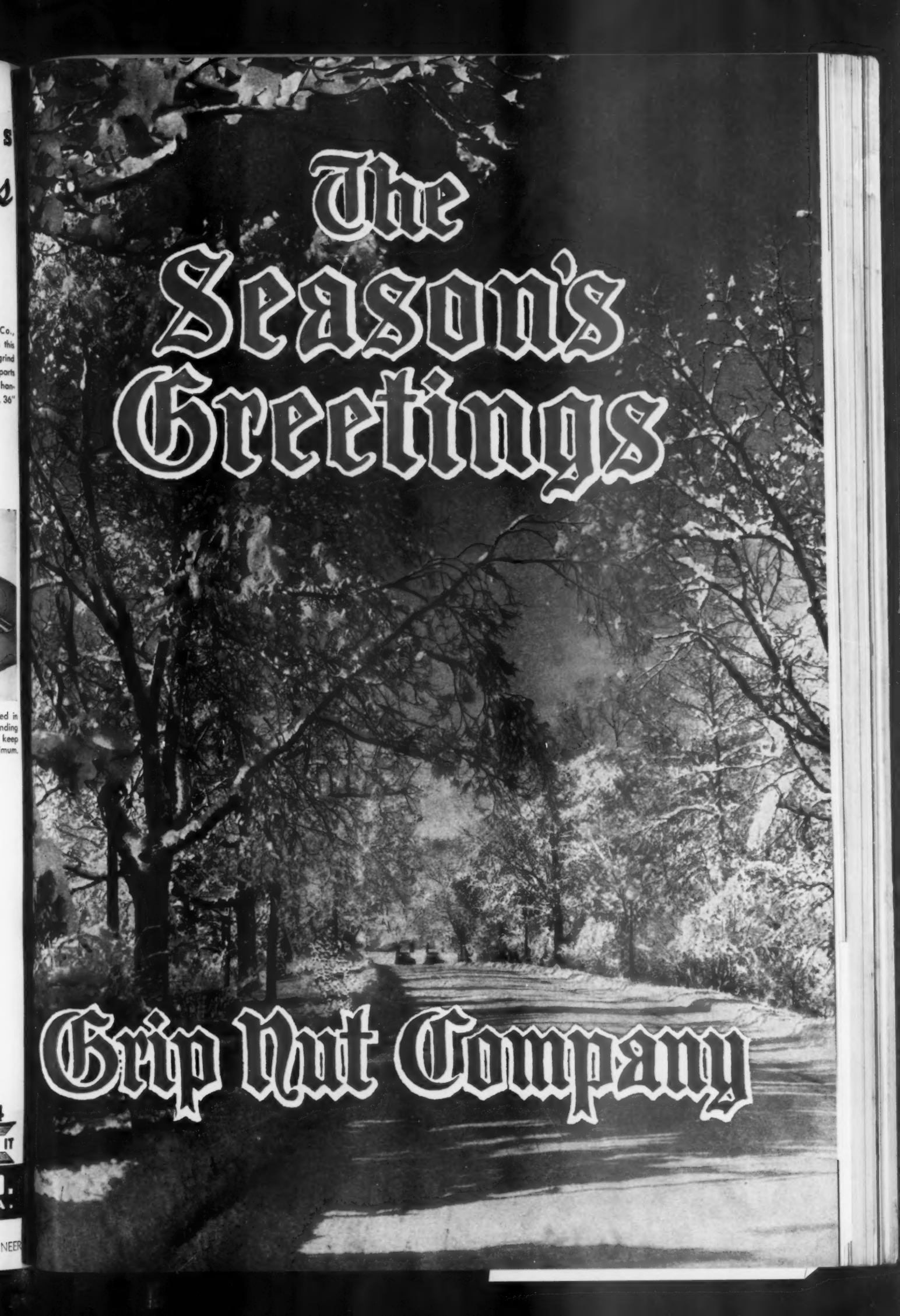
Write Today for Bulletin 161-8RL

HANCHETT HERMETI-COIL MAGNETIC CHUCKS

HANCHETT GRINDERS BIG RAPIDS MICHIGAN

IF IT'S A FLAT SURFACE—THERE'S A HANCHETT TO GRIND IT

HANCHETT MANUFACTURING CO.
BIG RAPIDS, MICHIGAN U.S.A.


The
Season's
Greetings
Grip Nut Company

Railroads Can Count on CRANE for this Vital Equipment

ONE SOURCE OF SUPPLY
ONE RESPONSIBILITY
ONE STANDARD OF QUALITY

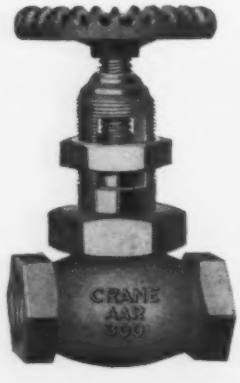
In meeting the needs of modernization and building programs . . . with complete assurance of ample selections and adequate supplies of these three classes of equipment . . . your logical partner is Crane. Depending on Crane not only simplifies buying procedures; you buy with complete confidence because of Crane Co.'s long experience in manufacturing to railroad standards and the ability to help apply this equipment most efficiently.

1. Modern Plumbing fixtures for passenger cars

Complete selections of smartly styled, compact, durably built fixtures in practical designs for all passenger accommodations. In every one installed in your cars, the sparkling, easy-to-clean beauty of Crane vitreous china, the dependability of working parts, plus the prestige of Crane in home plumbing, will give evidence of careful attention to travelers' comfort and convenience.

CAR PIPING EQUIPMENT—Crane Railroad Plumbing includes valves, fittings, and pipe for all utility services.

2. A.A.R. Valves & Fittings



Valves and fittings marked Crane-A.A.R. give you positive assurance of rigid adherence to specifications and of like dependability in every item. Choose from a wide range of brass globe and angle valves, and malleable iron fittings, unions, and union fittings, also A.A.R. forged steel unions.

3. Piping Materials for all railroad needs . . .

For a truly complete piping materials service—for installations in shops, power houses, service buildings, stations, or on rolling stock—come to Crane. Choose for every need from the world's largest selections of quality valves, fittings, pipe, piping specialties and fabricated piping—in brass, iron, and steel—for all working pressures and temperatures.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

RAILROAD SHOPS USE

AJAX FORGING MACHINES

FOR HIGH SPEED, LOW COST PRODUCTION OF A WIDE RANGE OF FORGINGS

RAILROAD shops continuously require a large variety of forgings such as Brake Pins, Grab Irons, Brake Hangers, Square Head and Hex Head Bolts, Miscellaneous Pins, Rivets, etc. Since forgings are such an important part of their daily production operations it is most essential that their forging machines provide the widest range and greatest dependability, coupled with high production at low cost. **AJAX FORGING MACHINES**, built on the basis of mechanical soundness, with their exclusive, patented mechanical features, meet these exacting requirements and are being used extensively in Railroad Shops throughout the world.

Write for Bulletin 65-B

THE **AJAX** MANUFACTURING COMPANY

EUCLID BRANCH P. O. CLEVELAND 17, OHIO

110 S. DEARBORN ST. • CHICAGO 3, ILLINOIS

"Built to take it!"

GARLOCK 7021 Compressed Asbestos Sheet Packing is available in sizes 40" x 40" and larger. Thicknesses 1/64" to ¼".

GARLOCK 7022 Gaskets—cut from this sheet—are available in all sizes and shapes.

Garlock 7021 Sheet Packing won't have to stand up against the impact of a rushing ram, of course, but if it did we think it could take it. For this compressed asbestos sheet is plenty tough. GARLOCK 7021 gives exceptional service on pipe lines and other equipment handling gasoline, oil, gas or steam at high temperatures and extreme pressures. Avoid gasket failures and expensive shutdowns by standardizing on GARLOCK 7021.

GARLOCK

7021

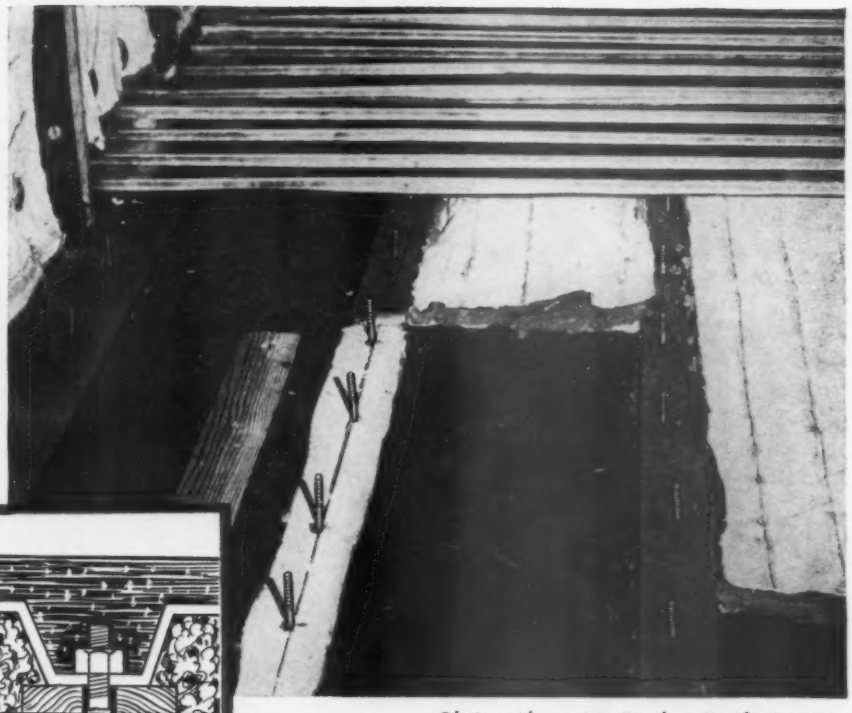
COMPRESSED ASBESTOS SHEET PACKING

THE GARLOCK PACKING CO.
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

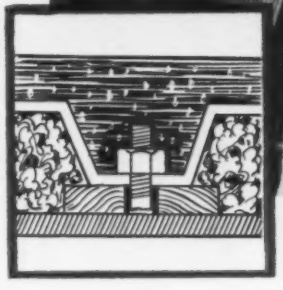
Another **NELSON** *cost-cutting Railroad Application*

How to speed up CAR RE-FLOORING with NELSON STUD WELDING



Photograph courtesy Southern Pacific Company

FORMERLY, the passenger car re-flooring job shown at right required drilling through car sills and floor beams to take through-bolts securing the furring strips and interlocked steel sub-flooring. In order to insert and tighten the bolts, it was necessary to remove much of the equipment underneath the car, all of which had to be reinstalled.



With the Nelson Stud Welder on the job, the necessary studs were welded on top the car sills and floor beam as shown in the photo (welding time, ½ second per stud). The drilled furring strips and sub-floor sections were slipped over the studs, nuts run down, and the composition flooring troweled in and finished. No under-car equipment was removed; in fact, no man was required beneath the car at any time. The result was a securely-anchored floor, completed days ahead of usual time.

Flooring installation is just *one* of the jobs that the Nelson Stud Welder can do *better* at substantial savings in time and money. Studs from ⅛" to ¾" in diameter, and up to 8" long, can be welded in any position in a half second; the completely-automatic Nelson Stud Welder is easily portable, works from any standard welding generator, and is compact for easy handling in "tight" places. It's a versatile tool that will more than pay its way in *any* shop, on repair, maintenance or new construction work. Full information available on request, or a demonstration at your convenience will gladly be made by our nearest Field Engineer. Write or wire:

NELSON

SALES CORPORATION

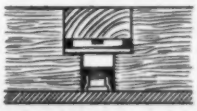
LORAIN, OHIO

Representatives and Distributors for

Nelson Specialty Welding Equipment Corp.
San Leandro, California

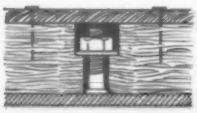
Nelson Stud Welding Corp.
Lorain, Ohio

OTHER NELSON FLOORING METHODS



SLOTTED NUT AND STUD

WATERTIGHT SCREW AND FEMALE STUD



STUD SECURING FURRING STRIP

OTHER NELSON FLUX-FILLED STUDS

INSULATION · EYE BOLT · BATTEN · METAL LATH · HOOK · LAGGING · METAL LATH · GROOVED · STIRRUP · FEMALE

Cars washed clean . . . at the rate of one car per minute

WHITING CAR WASHERS MEAN FAST, THOROUGH WASHING JOBS

Whiting Car Washers handle coaches, tenders, and Diesel-electric locomotives at the rate of 90 feet per minute—and cars go back into service *clean.* All models safeguard car finish by using either water sprays alone or cleaning solution, followed by a carefully timed water rinse. Self-aligning brushes automatically compensate for car tilt and assure thorough washing. Write for information.

WHITING
CORPORATION

15609 Lathrop Avenue, Harvey, Illinois

RAILROAD MAINTENANCE EQUIPMENT

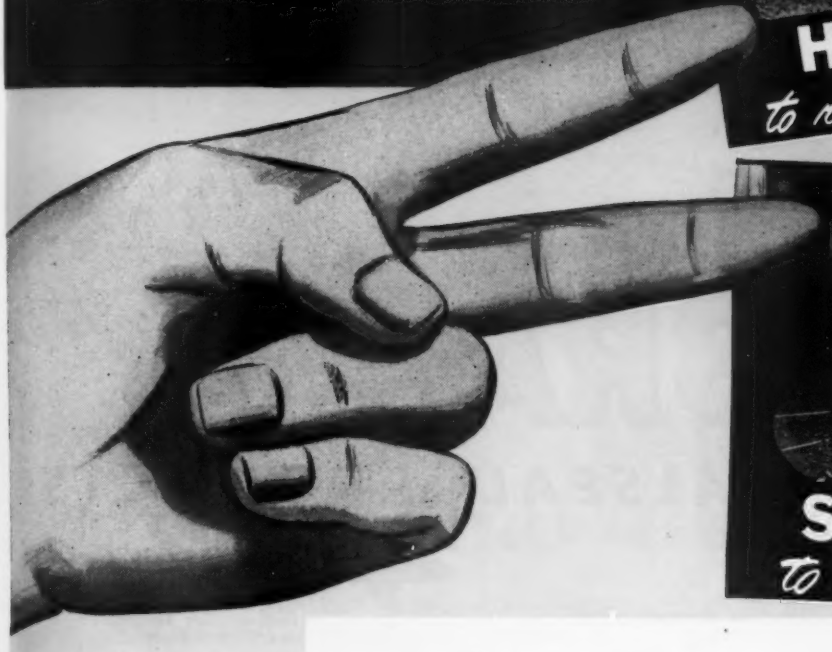
DROP PIT TABLES • LOCOMOTIVE HOISTS • HIGH-LIFT JACKS • LOCOMOTIVE SPOTTERS
CAR WASHERS • CINDER CONVEYORS • TRANSFER TABLES • CROSSOVER BRIDGES

Offices in Chicago, Cincinnati, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, and Washington, D. C. Agents in other principal cities. Canadian Subsidiary: Whiting Corporation (Canada) Ltd., Toronto, Ontario.

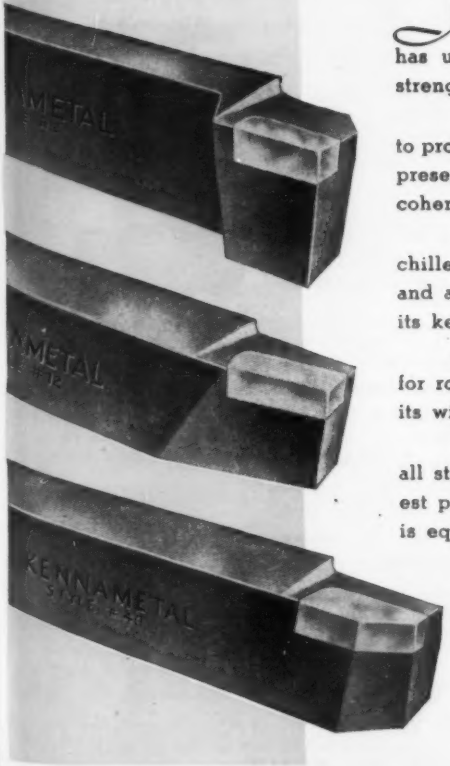
KENNAMETAL K6...

the 2 in 1 CAST IRON CUTTING GRADE

HARDNESS to resist ABRASION...



STRENGTH to resist SHOCK...



In providing a carbide for cast iron jobs involving rough or interrupted cuts it has usually been considered necessary to sacrifice some hardness for the sake of strength, with consequent shortening of tool life.

This is no longer necessary. Metallurgists of Kennametal Inc. have found a way to produce a 2 in 1 composition. It is hard *and* strong. These characteristics are both present to a high degree in Kennametal K6 grade, because of its uniform, strongly-coherent structure.

It has ample strength to withstand the shock of machining rough, sandy, or chilled castings, even though they are out of round, or have surface interruptions—and at the same time it has sufficient hardness to effectively resist abrasion, and hold its keen edge for a remarkably long time.

This new and improved tungsten carbide can be used with entire satisfaction for roughing, finishing, and precision boring. Scores of cases on record demonstrate its widespread effectiveness.

K6 blanks, and complete single point tools, are now available from stock in all standard styles and sizes. Use them on cast iron machining jobs to assure highest production with lowest tool cost. Remember also, that this grade of Kennametal is equally effective on milling—which is essentially interrupted cutting.

KENNAMETAL

SUPERIOR CEMENTED CARBIDES

TRADE MARK REG. U. S. PAT. OFF.

KENNAMETAL *Inc.*, LATROBE, PA.

FOR ALL THESE SERVICES...

Cut away view of a Walseal Tee showing ring of silver brazing alloy and completed Silbraz* joint.

Air brake piping on cars and Diesel locomotives

Water cooling lines on Diesels

Hot and cold water systems on cars

Air conditioning systems on cars

Lubricating oil circulating systems on Diesel locomotives

Steam heating systems using copper convectors, on cars and Diesel locomotives

specify

SILBRAZ ★ JOINTS

MADE WITH WALSEAL* PRODUCTS

Yes, on tough jobs like these, where brass or copper pipe or copper tubing is used, Walseal bronze valves, fittings, and flanges do a two-fold job.

1. They make leakproof, trouble-free connections that are permanent . . . vibration-proof, corrosion-resistant — connections that will not creep or pull apart; that literally join with the pipe to form a "one-piece pipe line."

2. They eliminate the need for maintenance and costly repairs — especially important where lowered operating costs are imperative.

For these reasons more and more piping installations are being made with the modern Silbraz joints, using Walseal products. For complete details on Walseal products, write for a free copy of Walworth Circular 84.

No. 95WS — 150-Pound Bronze Globe Valve with Renewable Disc, Lock-on Disc Holder, and Walseal Ends.

No. 225PWS — 350-Pound Bronze Globe Valve with "500 Brinell" Plug Type Seat and Disc, and Walseal Ends.

Walworth also manufactures a complete line of bronze, iron, and steel valves and fittings, including a complete line of bronze A.A.R. and Monel Globe and Angle Valves. A detailed description of the entire line is included in Catalog 42. Write for your free copy today.

*Patented — Reg. U. S. Pat. Off.

Make it a "one-piece pipe line" with WALSEAL

WALWORTH

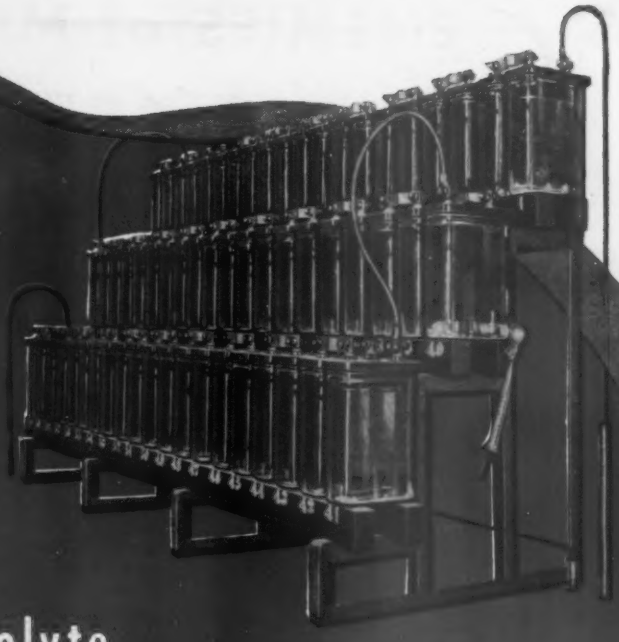
valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

PROBLEM:

To find insulated cable for battery-charging leads—immune to attack by electrolyte



SOLVED WITH FLAMENOL CABLE

An Ohio steel mill required insulated cable for its battery-charging equipment, which consisted of a 250-kw generator and a 27-panel switchboard. Cable was needed for leads from panels to batteries. As the leads ran underground, the cable insulation had to withstand moisture as well as electrolyte fumes and accidental contact with the electrolyte itself. Four years ago, at G.E.'s suggestion, Flamenol* Style FL insulated cable was selected for the job. The mill reports that the original installation is still giving trouble-free service.

RESISTS CHEMICALS— Flamenol Style FL cable is highly resistant to oils, water, mild acids, and alkalies—and weather. It is tough and stable, is flexible at low temperatures, and has high dielectric strength. Flamenol does not support combustion—therefore, prevents outages due to fires. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Its insulation strips easily and leaves the conductor surface untarnished.

A G-E "FIRST"— Only G.E. makes Flamenol cable. Flamenol is the original cable insulated with plasticized polyvinyl chloride. G.E. introduced it in 1935—not as a substitute for rubber-insulated cable but as a new type possessing desirable properties not obtainable in rubber. To find out how Flamenol can help solve *your* problem—save you time, trouble, and expense—ask our local office, or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.

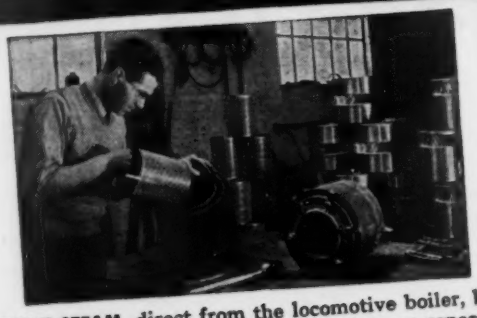
GENERAL ELECTRIC

502-54-1200

Keep on buying **BONDS** *—and keep all you buy*

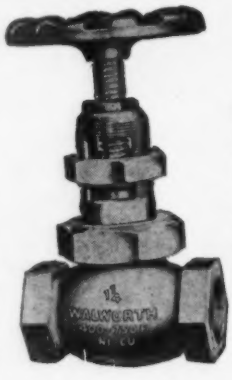
How 6 ENEMIES of METALS are being defeated in typical uses by Inco Nickel Alloys

ABRASIVE SCALE particles hammer at the seats of blow-off valves . . . corrosive and erosive hot waters add their destructive force. Yet the *first* Monel trim on a T.Z. valve used by the New Haven was still in service after 12 years! A recent count showed 272 of 331 New Haven locomotives equipped with Monel-trimmed T.Z. valves. A New Haven executive writes "...The Monel seats have given very satisfactory service . . . very few have been renewed . . ." ***INCO Nickel alloys defeat abrasion.***

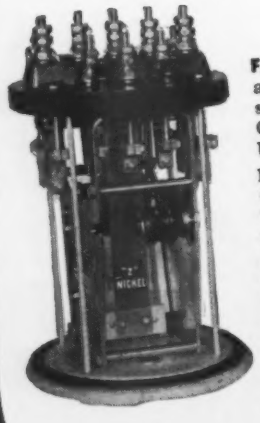


EROSIVE STEAM, direct from the locomotive boiler, blasts with full force at the inner cylinders of steam separators, often causing failure in as little as 3 months. Over 4 years ago, the Dri-Steam Products Co. fabricated a new-type separator of Monel. Since then, with more than 300 in service, not one Monel separator has failed! In addition to long life, the Monel separator costs 30% less . . . weighs only half as much as separators made of the metal formerly used. ***INCO Nickel alloys defeat erosion.***

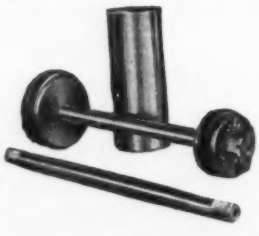
CORROSIVE WATERS cannot harm the fine (.006") wires that form the Knit Metal Mesh feedwater filters used by the Vermont Central R. R. The 14" x 20" pads provide 15,000 square inches of filtering surface with a million meshes to snare dirt, scale and oil from the feedwater. They are easily cleaned with steam or any ordinary solvent . . . resist breakage and corrosion because they are knit of strong, tough, corrosion-resistant MONEL. ***INCO Nickel alloys defeat corrosion.***



TEMPERATURES TO 750° F....more than 200° F. beyond the limit usually considered reasonable for bronze valves . . . and pressures to 400 psi. had to be handled by valves in Burlington Engine No. 3012, built in 1935. Walworth built valves with all-Monel bodies were installed. Now, after more than 1,150,000 miles of service, the majority of the original Monel valves are still at work. Burlington states: "Monel valves are one of the few foolproof parts of a locomotive." ***INCO Nickel alloys defeat high temperatures.***



FATIGUE . . . 100,000,000 flexings a year must be withstood by the spring pendulum used in the Code Transmitter built by the Union Switch and Signal Company. The transmitter, operating directly through track rails to wayside signal, engine cab signal, or both, shows traffic conditions on the trackage under its control. The spring which vibrates as much as 100,000,000 times a year is made of fatigue-resistant "Z" Nickel. In years of service, not one "Z" Nickel transmitter spring has worn out. ***INCO Nickel alloys defeat fatigue.***



HEAVY STRESSES, corrosive gases and abrasive grit gang up on locomotive boiler feed pumps. Sending 110 to 200 gallons of water into the boiler at a rate of 74 to 80 strokes per minute, the pump must withstand heavy stresses. The rods are exposed to grit, sleet and corrosive gases. Linings must retain a smooth highly polished surface. Since 1922, Worthington Pump & Machinery Co. has been making vital parts of these pumps from Monel. ***INCO Nickel alloys defeat heavy stresses.***

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

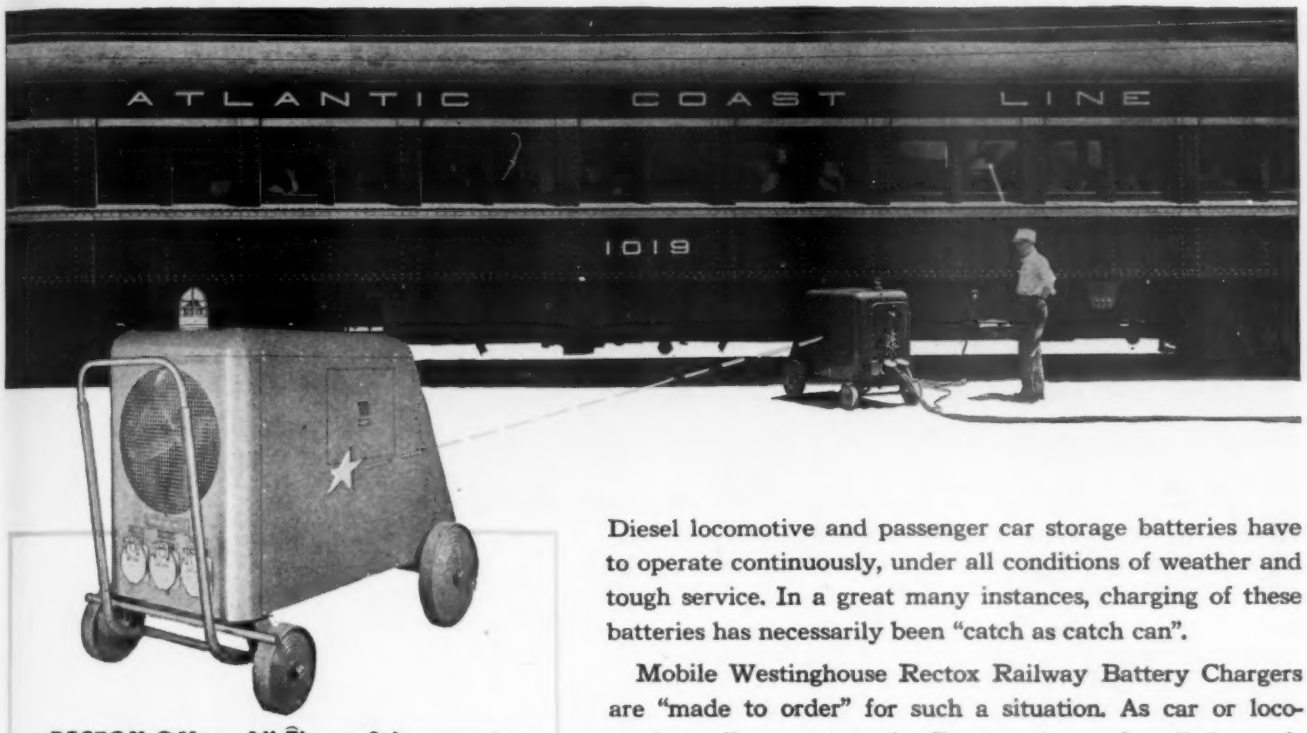
NICKEL (INCO) ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • Sheet . . Strip . . Rod . . Tubing . . Wire . . Castings . . Welding Rods (Gas & Electric)

RECTOX BATTERY CHARGER

Meets all Trains

FOR A FULL-CHARGE *IN THE YARD* OR A BOOSTER-CHARGE ON A SHORT *"LAYOVER"*



Diesel locomotive and passenger car storage batteries have to operate continuously, under all conditions of weather and tough service. In a great many instances, charging of these batteries has necessarily been "catch as catch can".

Mobile Westinghouse Rectox Railway Battery Chargers are "made to order" for such a situation. As car or locomotive rolls to a stop, the Rectox charger is rolled up—is plugged into the 230-volt, 3-phase, 60-cycle, a-c outlet, also plugged into the battery . . . the selector and tap switches set, and the battery is immediately "on charge".

Car or locomotive *standing time* becomes Rectox *charging time*—from short boost to full seven to eight-hour charge.

The nonautomatic type is for manual control, boost charging.

The automatic type has a temperature compensated voltage relay for two-rate charging of lead-acid batteries. Nickel-Alkaline batteries are charged by the modified constant current system. An adjustable time switch automatically terminates the charge.

Another invaluable Westinghouse contribution to modern railroading, Rectox is timesaving, battery-saving and moneysaving. For complete information call your nearest Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-21354

RECTOX Offers All These Advantages

ADAPTABLE—Automatic or nonautomatic types available; for either Diesel locomotives or passenger car batteries.

ROLLS FROM CAR TO CAR—Its narrow width permits use between adjoining tracks. Low center of gravity minimizes danger of tipping. Has parking brake.

DEPENDABLE AND "TROUBLE-FREE"—over an unlimited life, with low maintenance.

ECONOMICAL—High charging efficiency, particularly on 50% to 75% load, lowers power costs.

SAFE—Thermal-overload protection; battery circuit fused.

A RECTOX COPPER OXIDE DISC

The Rectox plate assembly is composed of a series of large copper oxide plates, 4⅜" x 12" assembled on an insulated bolt. Rectox Rectifiers, installed more than 16 years ago, continue to give dependable operation.

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Rectox RAILWAY BATTERY CHARGERS

Build up worn Crown Brass this service-proved way

CROWN BRASS and other bearing surfaces that have become worn can be reconditioned quickly and economically with Airco No. 19 bronze. This electrode was developed especially for building up worn bearing metal by welding, and it is successfully employed by a number of railroads.

Airco No. 19 bronze has a high lead and tin content, with virtually the same analysis as poured brass bearing metal. It is applied either by carbon arc or metallic arc welding.

Quantities of worn crowns may be built up quickly by use of a positioner similar to that shown above. The bronze deposit is applied to the back and face of the crown for a distance of four or five inches from the toe edges.

Crown and back end main rod brasses after having been built up with Airco No. 19 bronze.

Service-worn welded crowns can be rebuilt many times by welding providing the brass remains in good condition.

Driving box laterals, shoes, wedges, and other locomotive wearing parts can be rebuilt and maintained economically by this method. For further information, fill in the coupon, and mail today.

RME

Air Reduction

60 East 42nd St.
New York 17, N.Y.

Please send me a copy of explanatory folder ADG-2011.

*Firm*_____

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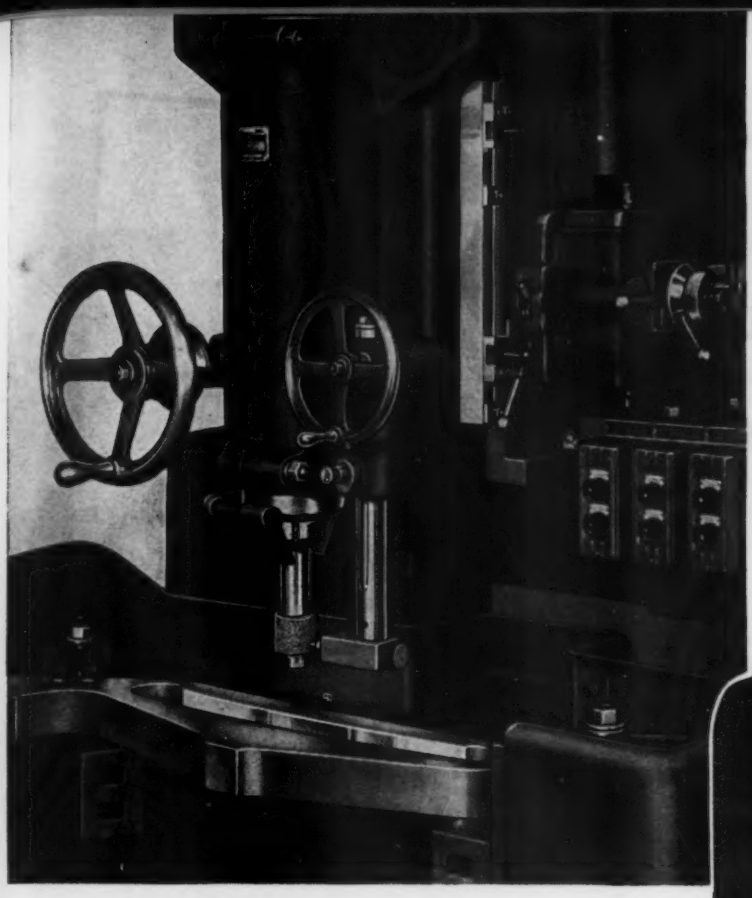
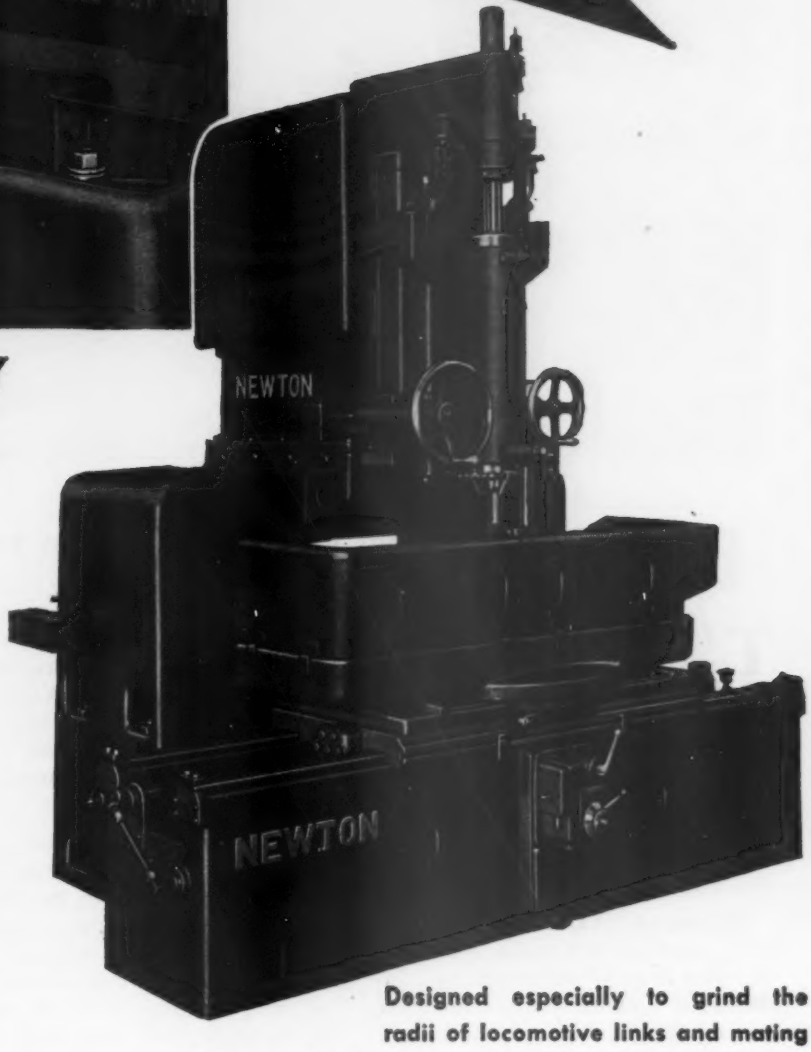


A NEW CONSOLIDATED RAILROAD SHOP TOOL

NEWTON HEAVY DUTY RADIUS LINK GRINDING MACHINE

Bulletin No. 850 covering this new Newton Radius Link Grinding Machine is now ready. Send for your copy today.



Among Railroad Tools built by Consolidated are . . .

CAR WHEEL BORERS
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TIRE MILLS
END DRIVE AXLE LATHES
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JOURNAL TRUING LATHES
PROFILE MILLING MACHINES
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AND OTHERS

Designed especially to grind the radii of locomotive links and mating blocks. Soundly engineered design, extra construction rigidity and positive accuracy provide for faster, better and more economical operation.

BUILDERS OF RAILROAD SHOP TOOLS SINCE 1861

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CONSOLIDATED MACHINE TOOLS

CONSOLIDATED
MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

HYCAR... a modern material for tomorrow's modern trains

There are important uses for HYCAR on every train... in every yard

TOMORROW'S trains, both freight and passenger, will be—above all—modern. They will be faster, safer, better-looking, more comfortable, more efficient, more dependable. They will also be more economical to operate, thanks in part to HYCAR synthetic rubber, a *modern* material that will contribute to the new efficiency and dependability.

The use of HYCAR has improved hose, gaskets and seals, bushings, vibration dampeners, mountings, diaphragms, window strips, floor mats, and dozens of other rubber parts. Wherever there is a resilient part—in train or yard—that's exposed to oil, dirt, abrasion, sun, heat, cold, or other destructive elements, that part should be made from HYCAR. HYCAR parts give dependable performance throughout a long life, and save money by reducing maintenance and replacement expense.

As suppliers only of raw synthetic rubber we make no finished parts of HYCAR. But we will be happy to cooperate with you and your supplier in the development of rubber products requiring specific combinations of the properties shown in the box at the right. For assistance in your problems write *Hycar Chemical Company, Akron 8, Ohio.*

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW — even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY — down to —65° F.*
6. *LIGHT WEIGHT — 15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

Hycar

Reg. U. S. Pat. Off.

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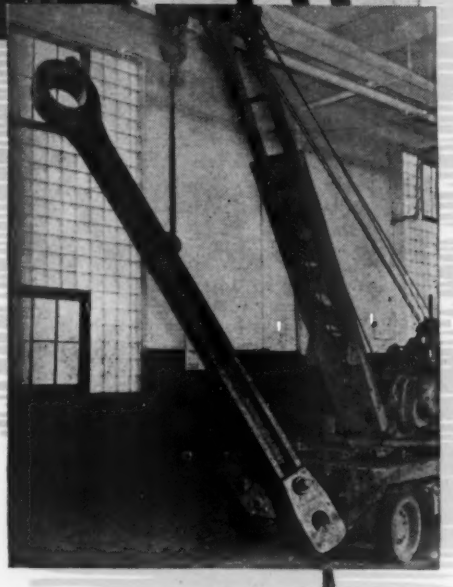
Synthetic Rubbers



WHAT A GRIP!

Handle shop and derrick lifts safely with YELLOW STRAND *BRAIDED* SLINGS*

Scores of railroads have taken a fresh hold on the sling question as a result of wartime experience in shortening lay-up time. And what a grip *you'll* get by using Yellow Strand *Braided* Safety Slings in shops, yards, stores departments and on wreckers. Here you see such varied lifts as a steam locomotive, flat car (at the drawbar), main rod, pair of axles — and the list could include Diesel-electric bodies, motors, pistons, trucks, wheels, brake rigging assemblies and numerous other parts.

Tough Yellow Strand Wire Rope provides the strength in this efficient sling. The patented *braiding* adds flexibility, kink-resistance and a snug grasp on odd-shaped objects. The combined result is a time-and-labor-saving sling with less weight than chain of like capacity... with limberness well suited to Manila rope jobs... with greater security for men and loads.

Properly fitted, Yellow Strand *Braided* Slings will give long-lived, economical service. Write now for information. Broderick & Bascom Rope Co., St. Louis 15, Mo. *Branches:* New York, Chicago, Houston, Portland, Seattle. *Factories:* St. Louis, Seattle, Peoria.

RIGGERS' HAND BOOK FREE
Shows sling types, fittings, capacities. Write for your copy.

*PATENTS: U. S., 1475869, 1834671, 2142641, 2142642, 2200568, CANADIAN, 252874, 298068

ARMY E NAVY

BRODERICK & BASCOM

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BRAIDED SAFETY SLINGS

THE CHAMPION
RIVET COMPANY
CLEVELAND, OHIO
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Keep that pencil sharp with FIRTHITE

Here's Why!

During the war it was a matter of *production speed* . . . and carbide cutting tools were the answer.

Today it's a matter also of keeping operating costs down. High production, yes . . . but at costs that meet or beat competition. Again Firthite sintered carbide tools will help you keep red ink out of your records, while turning out a better, more salable product.

if you have a tool or die problem

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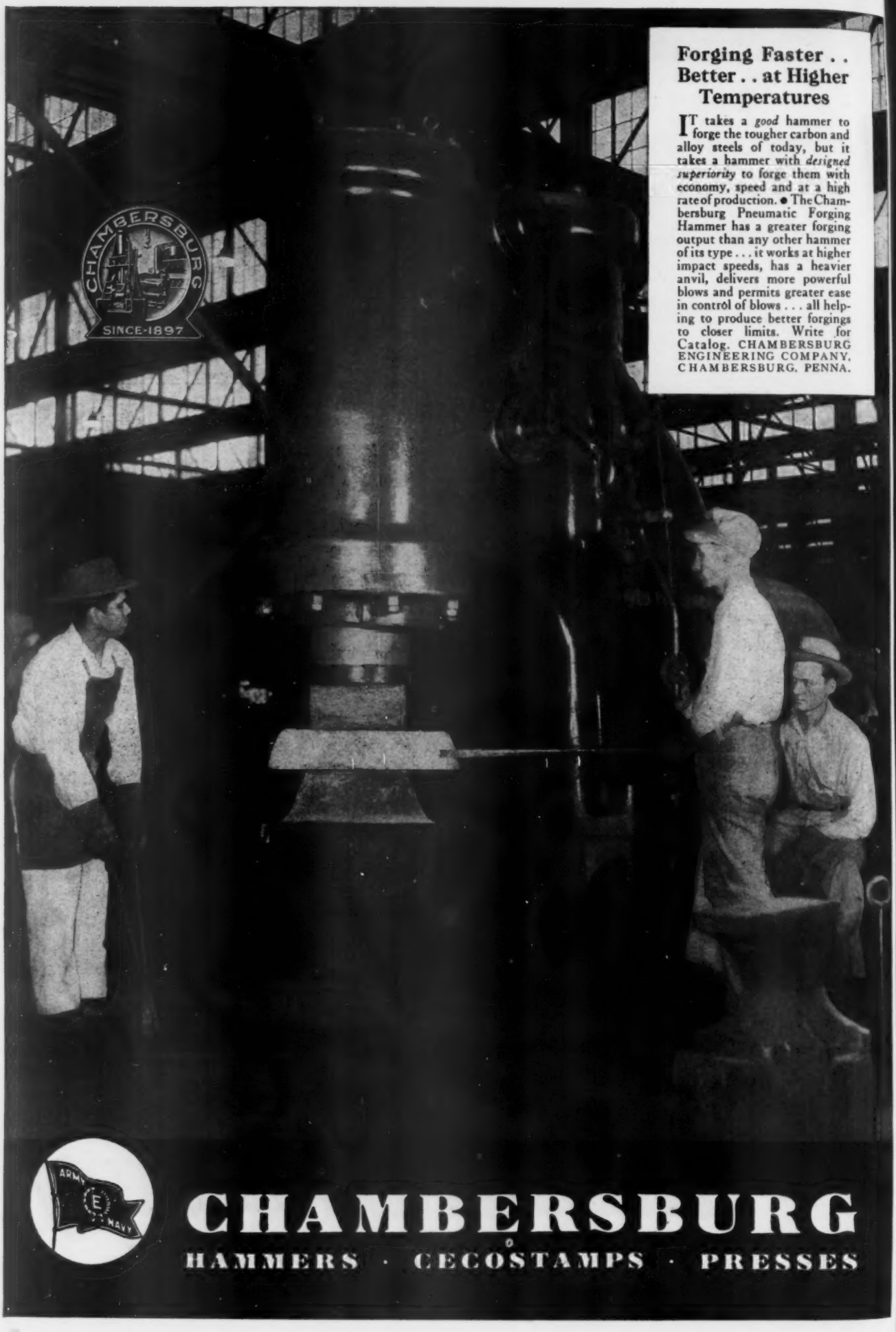
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Forging Faster . . Better . . at Higher Temperatures
IT takes a *good* hammer to forge the tougher carbon and alloy steels of today, but it takes a hammer with *designed superiority* to forge them with economy, speed and at a high rate of production. ● The Chambersburg Pneumatic Forging Hammer has a greater forging output than any other hammer of its type . . . it works at higher impact speeds, has a heavier anvil, delivers more powerful blows and permits greater ease in control of blows . . . all helping to produce better forgings to closer limits. Write for Catalog. CHAMBERSBURG ENGINEERING COMPANY, CHAMBERSBURG, PENNA.
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NAVY
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HAMMERS · CECOSTAMPS · PRESSES

QUESTION:

Just how effectively can used oil be restored?

ANSWER: SO EFFECTIVELY THAT OIL NEED NEVER BE DISCARDED!

QUESTION: ***What Steps Are Necessary to Restore Oil for Re-Use?***

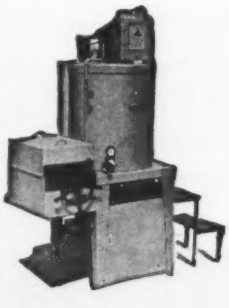
ANSWER: *For best results, the oil should be* heated, *to remove moisture and fuel dilution (if present). Then, solids, asphaltic materials and acids should be removed by contact with earth and filtration. Acidity should be reduced to new oil values.*

QUESTION: ***Can All These Steps Be Carried Out in a Single Piece of Equipment?***

ANSWER: *Yes, the YM Oil Refiner, a single self-contained unit, provides for* both *heating of the used oil, and for* two-stage *filtration.*

QUESTION: ***Is the YM Process Economical and Simple to Operate?***

ANSWER: *For every dollar spent for filtering materials, the YM method removes more pounds of contaminants than any other method known. Automatically controlled, the Oil Refiner needs little attention from the operator—no special skill is required.*



QUESTION: ***Is the Restored Oil Equal to New Oil?***

ANSWER: *Oil restored in the YM Oil Refiner can be used in the same manner and place as new parent oil. In fact, the restored oil, having been tempered, is frequently* more stable *than new oil.*

QUESTION: ***What Kinds of Oils Can Be Restored in a YM Unit?***

ANSWER: *Practically any kind used by industry. You'll find a helpful list in our YM bulletin—just mail the coupon for a copy. Or write us about your specific problem.*

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1221 Kidde Avenue
Belleville 9, New Jersey

Gentlemen:
Please send me further information about the YM Oil Refiner—and names of users in this locality.

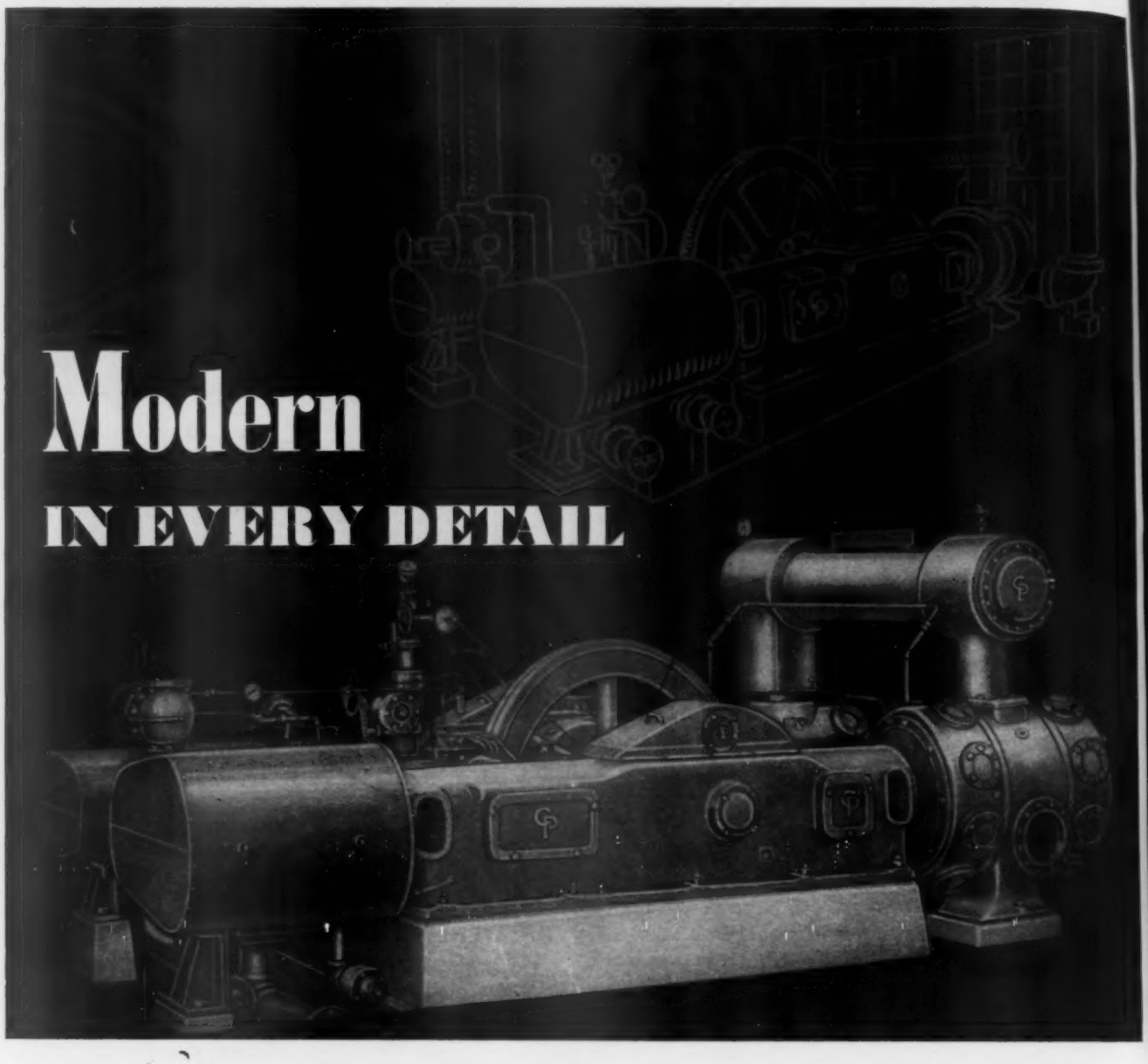
Name_____

Position_____

Company_____

Street Address_____

City and State_____



CLASS H STEAM DRIVEN COMPRESSOR

FORTY years of experience went into the building of CP Class H – latest model of CP Steam Driven compressors.

A thoroughly modern steam end, proportioned to the purchaser's steam conditions, combined with full force-feed lubrication of the running gear and a highly efficient air end with its Simplate Valves, all contribute to the high overall economy of these CP machines. The double crosshead-tie rod construction provides direct, straight-line transmission of power from steam end to air end. Capacities range from 400 to 6600 c.f.m., 100 to 125 pounds air pressure. Other sizes in single and multi-stage design for lower and higher pressures. Write for literature.

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FOR EFFICIENT MAINTENANCE OF AB BRAKES

This handy, compact Snap-on wrench set includes all tools needed for dismantling and assembling brake cylinders, and removing and applying AB valves and triple valves . . . *faster and easier!*

The advantages offered by this highly efficient kit over the hit-and-miss selection of ordinary tools are obvious. Proved in actual service . . . many shops are now standardizing on these sets for maintenance of AB brakes.

Write for further information on Snap-on AB kits. Snap-on offers a wide range of tools particularly adapted for railway maintenance operations. Complete catalog of 3,000 Snap-on tools on request.

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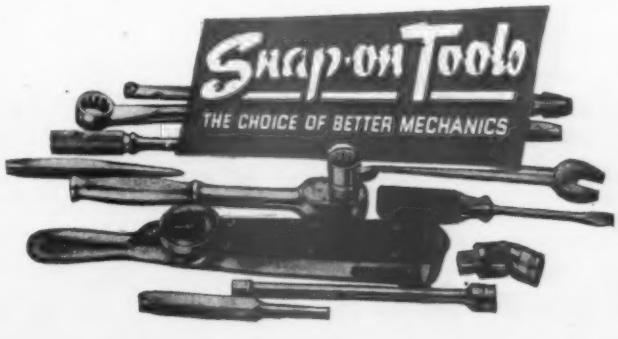


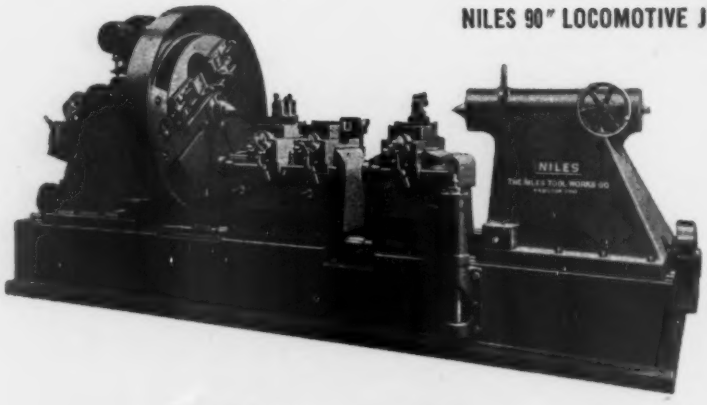
The Niles "BIG 3" for Locomotive Shops

NILES 90" BALANCED QUARTERING AND PIN TURNING MACHINE

● Successful operation of locomotive crankpins depends upon accuracy of parallelism between the pin and axle, accurate quartering, accurate positioning for stroke, and lack of taper in the crankpins. The Niles 90" Balanced Quartering and Pin Turning Machine provides all these features.

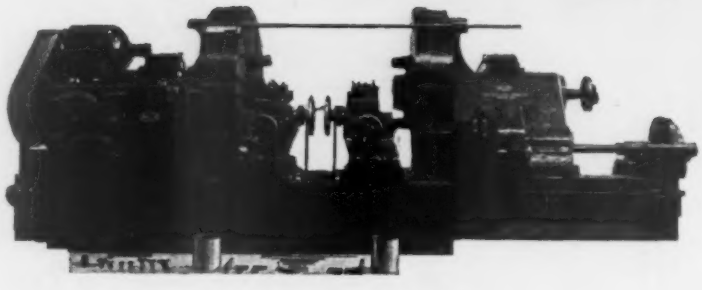
Niles quartering machine recently installed in large mid-western railway shop

NILES 90" LOCOMOTIVE JOURNAL TURNING LATHE



● Produces accurate and smooth journals on all classes of locomotive driving and trailer wheel sets. The two inside journals of driving wheel sets may be turned or burnished or both hub liners faced simultaneously.

NILES 90" HEAVY DRIVING WHEEL LATHE



Designed for the heaviest tread and flange contour turning duty with modern tool steels. Saves time, saves labor, gives maximum production with accuracies required for high speed locomotive operation.

NILES

Present-day high-speed operating schedules are possible and practical only when shop work has been held to the highest standard. Niles tools enable you to maintain this standard.

Write for catalog of Niles Railway Tools

★ Over 100 years experience building high quality into a vast quantity of machine tools.

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HAMILTON, OHIO

REPRESENTED THROUGHOUT LATIN AMERICA BY MACHINE AFFILIATES, INC.

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Like the sun, the earth, the atom, the Wing Unit Heater REVOLVES. It keeps the heated air in gentle motion, slowly circulating a constant, uniform, EVEN temperature, transforming hot and cold spots into comfortable, energizing, productive areas. The circulating heated air from the slowly revolving discharges reaches to farthermost corners, gets around and under obstructions, eliminates hot spots and cold spots.

Install Wing Revolving Unit Heaters now. Not only will they heat your plant comfortably and evenly, bringing a sensation of fresh, live, invigorating warmth to workers, but in the Summer, with the steam turned off and the fans on, they create a pleasant, cooling air motion over the entire area. *Write for Bulletin HR*

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TURBINE BLOWERS · TURBINES · MOTOR DRIVEN BLOWERS · VENTILATING FANS · DUCT FANS · HEATING UNITS · SHIP VENTILATORS

IN ROUNDHOUSE
or CAR SHOP

OLIVER

RAILROAD FASTENERS

CONSERVE VITAL MAN-HOURS..
AID IN DEPENDABLE, ECONOMICAL
OPERATION

The high quality, uniformity and dependability of Oliver bolts, nuts and rivets mean faster assembly, better joints. In building or repairing cars and locomotives, work goes faster when you use the proper types and sizes of accurately made, close-fitting Oliver fasteners.

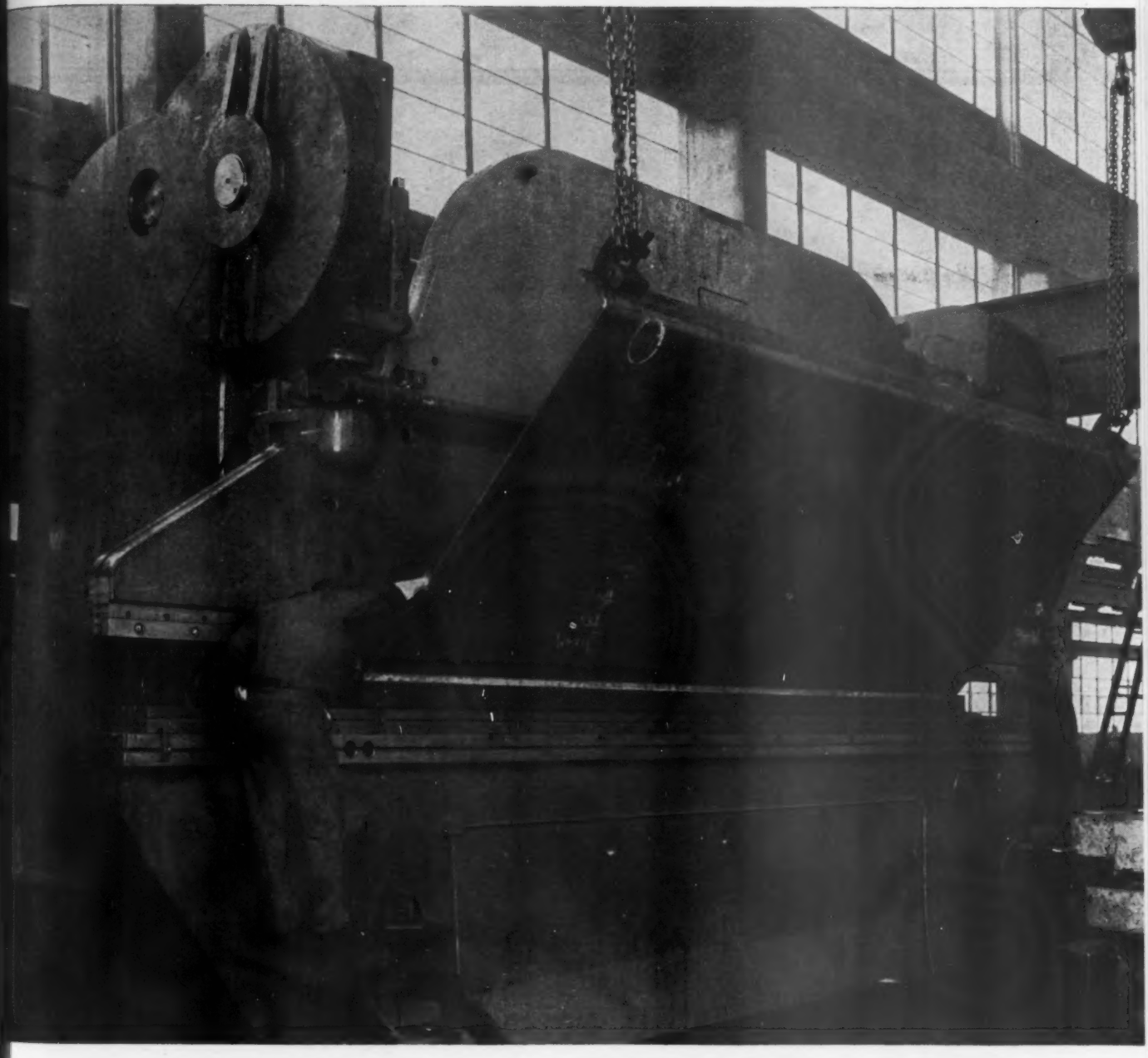
Years of experience and modern equipment enable us to produce, in quantity, the types of fasteners needed for railroad service.

Write for the Oliver Railroad Catalog No. 4. Lists bolts, nuts, rivets, gage rods and other accessories.

OLIVER
IRON AND STEEL
Corporation

SOUTH TENTH & MURIEL STREETS · PITTSBURGH 3, PA.

One Stroke bends a ¾ inch Steel Plate 20 feet long



New manufacturing requirements have been met by the largest two housing mechanical brake in the world. Operating with machine tool accuracy, this Cincinnati Press Brake—weighing 125 tons with twenty feet between housings and thirty feet of over-all die surface—exerts 1000 tons pressure and in construction required the use of the largest rolled steel plates ever produced.

Write for our Catalog No. B-2 on Press Brakes and their many uses.

THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

THE EDITOR'S DESK

MANUFACTURERS' WAR RECORDS!

The general public is more or less acquainted with the truly remarkable contributions made by American railroads to the winning of the World War. It is not, however, so well informed as to the vital and, in many instances, dramatic part played by the railway supply manufacturers. For that reason it is hoped that more pithy and attractive publications, similar to the booklet issued by the American Locomotive Company, entitled, "American Locomotive Went to War", will be published.

In terse and well-illustrated form, it reviews briefly the high spots in its startling performance, covering the production of a wide variety of war products. During the first four years of the war it produced more than a billion dollars of materials, or more than during the first twenty-five years of the century. Its output in 1943 was eighteen times that of 1939.

These figures, while amazing, do not disclose adequately the achievements in manufacturing and engineering skill, which enabled this and other companies to develop and rush special equipment to the front in times of grave emergency. There is little question, for instance, but that the M-7 tanks, developed and manufactured at the Schenectady plant in record time, were an important factor in turning the tide against the Nazis in North Africa.

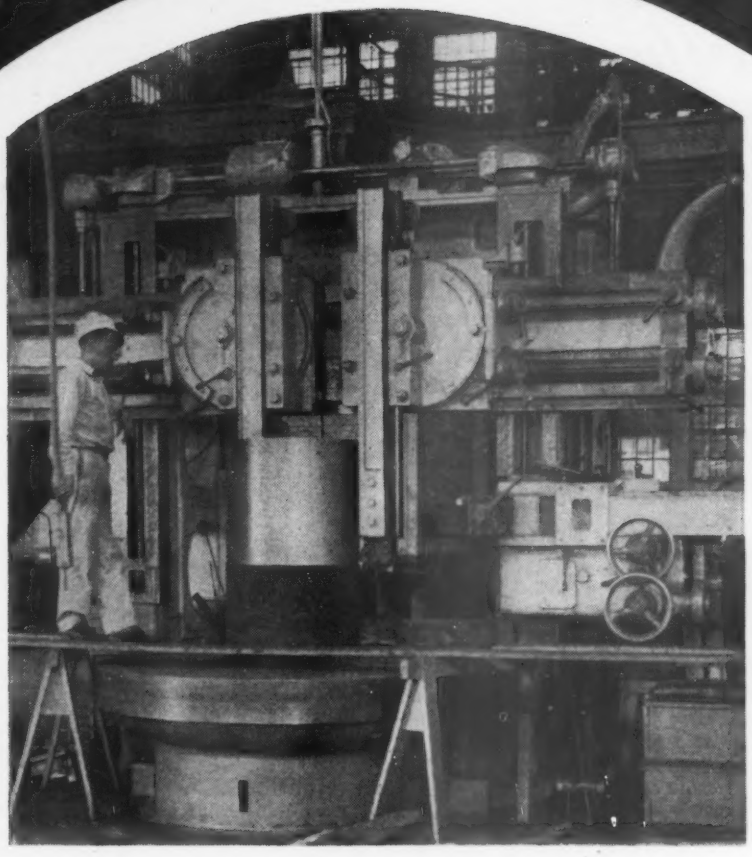
This is only one of many important performances which earned the Army-Navy E with Star and the Navy E with Star for the Schenectady Plant, the Maritime M with four Stars for Dunkirk, and the Army-Navy E with two Stars for the Latrobe Plant of the American Locomotive Company.

All honor to the railway supply manufacturers for the fine engineering and production contributions made in a time of crisis by an industry which ordinarily confines its attention in large measure to supplying the current needs of the railroads. The railroad industry—including both the railroads and supply manufacturers—has given an excellent account of itself in these critical war years.

Roy V. Wright

CYLINDER BUSHINGS

the KING way



THAT railroads are going "The King Way" more and more is exemplified again by the recent installation of this new 84" King double column Boring Mill in an important southern railroad shop.

While rugged construction, and their power and stamina to take the heaviest cuts at maximum speeds are outstanding features of all King Boring and Turning Mills, they are also accurate and produce a super-smooth surface machined to a micrometer fit.

The above illustration shows the King Mill boring and turning cylinder bushings 28½" O.D. — 27" I.D. and 42½" long.

The machine, which is fitted with three heads, ram, turret and side, will take the heaviest cuts at highest speeds which the best cutting tools will withstand when machining jobs within capacity. You can obtain King Heavy Duty Double Column Mills from 52" to 144" swing — either with or without side heads.

The KING MACHINE TOOL Company

BUILDERS OF VERTICAL BORING AND TURNING MACHINES EXCLUSIVELY

CINCINNATI, OHIO

SEMPER FIDELIS

Always faithful to 'round-the-clock duty

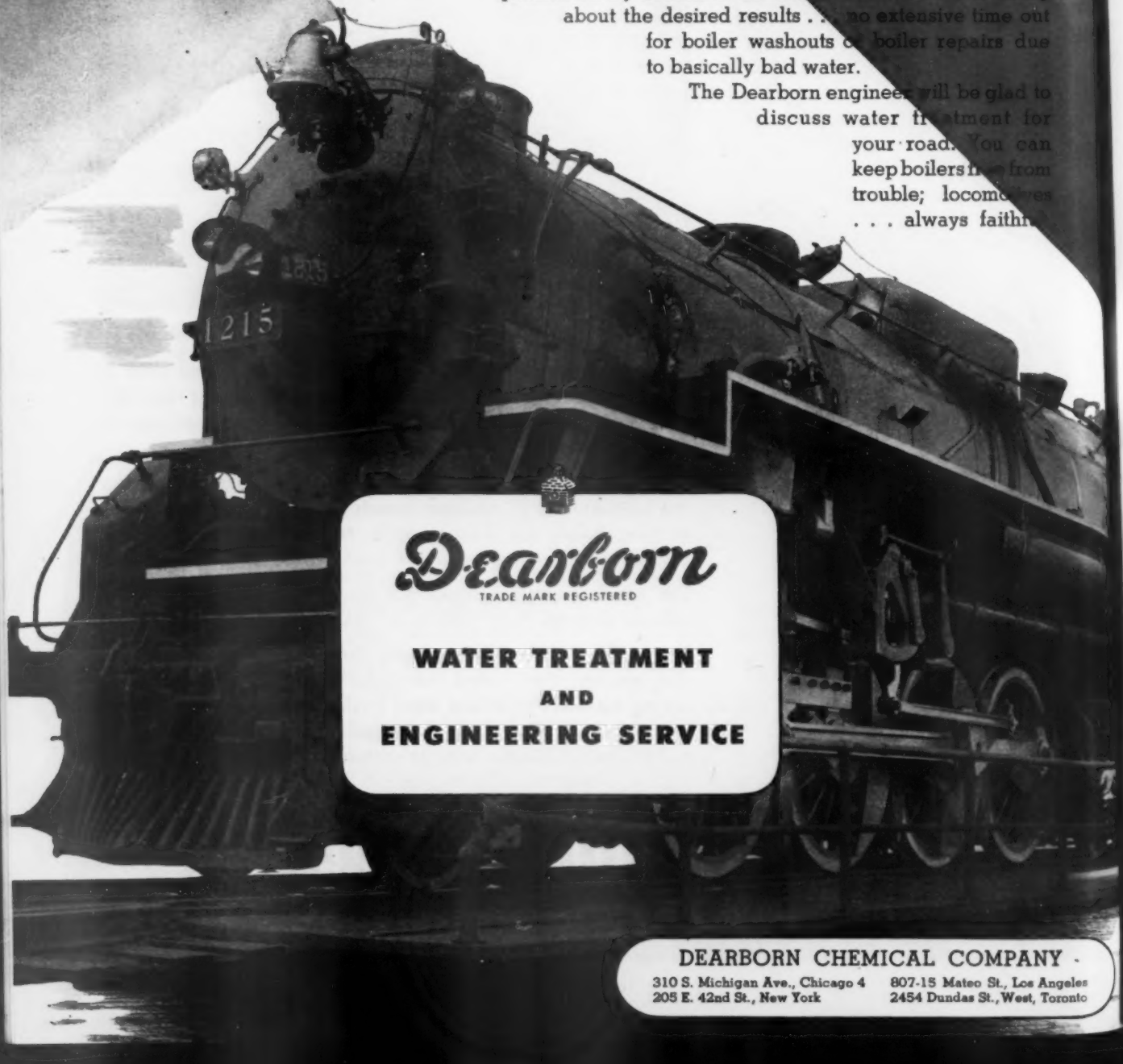
. . . . . thanks to Dearborn

Even now, the railroads, which have served our country so well, cannot relax. Their locomotives still must meet strenuous traffic demands during military demobilization.

Over 200 railroads employ Dearborn water treatment and service. We, at Dearborn, are justifiably proud of our share in keeping locomotives full of energy for continuous duty . . . with boilers free from scale, corrosion, and foam.

Frequent analyses of feedwater, chemical formulas to meet conditions at each water station, supplemented by scientific control work in the field, bring about the desired results . . . no extensive time out for boiler washouts or boiler repairs due to basically bad water.

The Dearborn engineer will be glad to discuss water treatment for your road. You can keep boilers free from trouble; locomotives . . . always faithful.



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Complete specifications on CINCINNATI *No. 3 Centerless Grinding Machines may be obtained by writing for Catalog G-438-3. For a brief description of these machines, look in Sweet's Catalog File for Mechanical Industries.*

Grinding FRAME BOLTS

100 PER HOUR ON A CINCINNATI NO. 3 CENTERLESS

● These illustrations show a CINCINNATI No. 3 Centerless set up for grinding frame bolts by the infeed method. The complete length of the bolt under the head is ground to size in one operation. ¶ There are several reasons for using a No. 3 Centerless for jobs of this type. It is potentially a high production machine, yet it has a number of features to facilitate setup. Heavy duty construction permits unusually wide contact between work and wheel; FILMATIC grinding wheel spindle bearings withstand heavy cuts with no special attention; hydraulic profile truing over both wheels facilitates and speeds up the truing and dressing of the wheels; large diameter infeed handwheel with micrometer adjustments gives you diameter reduction as fine as .0001". ¶ The CINCINNATI No. 3 Centerless Grinder has a very definite place in railway shops. It will be to your advantage to investigate further.

Write for booklet G503-1 "Principles of Centerless Grinding," an unusually informative booklet which is written in nontechnical language. This booklet also contains a chapter on small lot production.

CINCINNATI GRINDERS INCORPORATED

CINCINNATI 9, OHIO, U.S.A.

CENTER TYPE GRINDING MACHINES • CENTERLESS GRINDING MACHINES • CENTERLESS LAPPING MACHINES

Western Maryland Shay

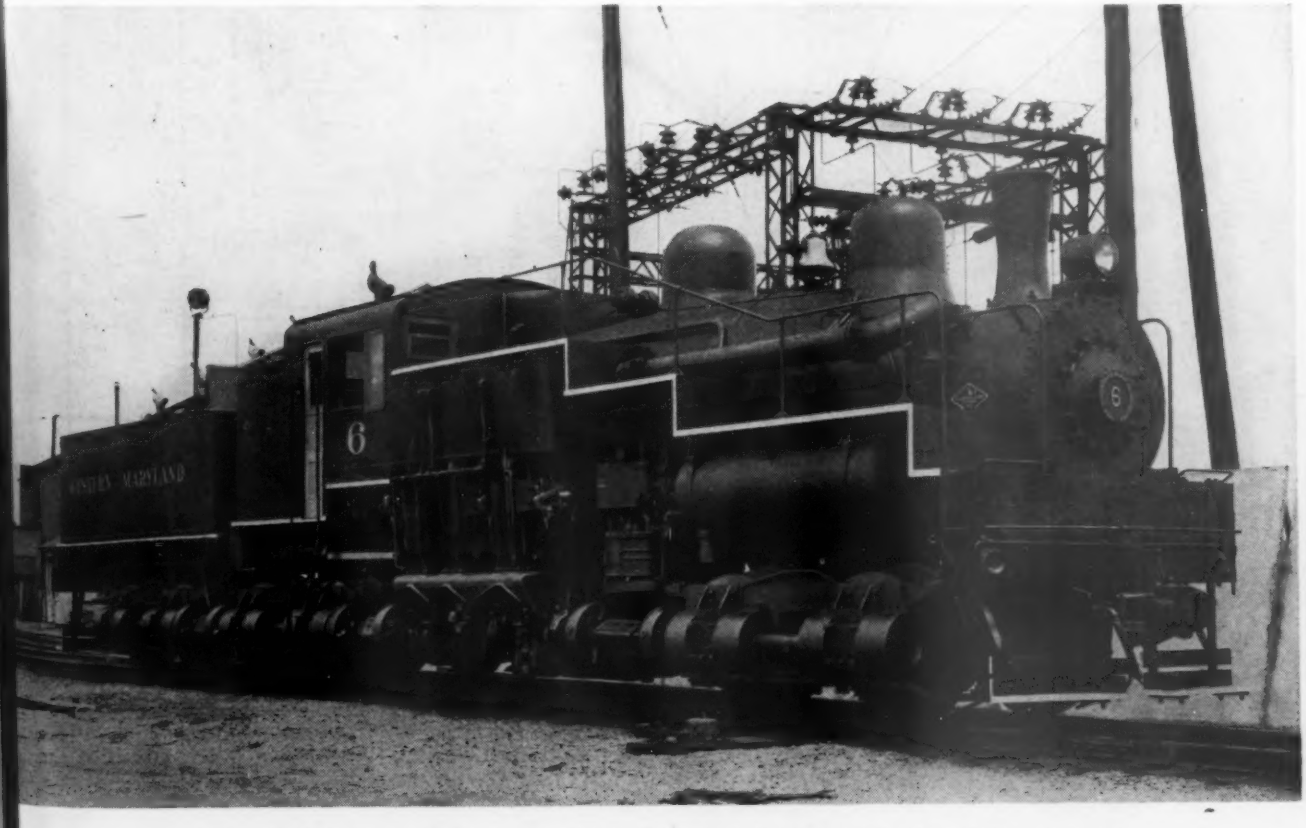
Lima-built geared locomotive having a tractive force of 59,740 lb. and a total weight of 324,000 lb. is designed for operation on 7 per cent grades and 22 deg. curvature

THE Lima Locomotive Works has recently delivered to the Western Maryland a Shay geared locomotive having a total weight of 324,000 lb. and a tractive force of 59,740 lb. This locomotive is designed for regular operation on 7 per cent grades with occasional stretches up to 10 per cent with maximum curvatures up to 22 deg. The trailing loads that can be handled at various speeds and on different grades are shown in an accompanying table. It is used on a coal-mining branch that connects with the Western Maryland near Chaffee, W. Va., between Cumberland, Md., and Elkins, W. Va., and is located on the headwaters of the Potomac river. The branch, originally a narrow gage, was built in 1904 by the Three Forks Coal and Coke Company and was converted into a standard gage in 1912. The Western Maryland acquired the branch line in 1929 and has operated it since that time.

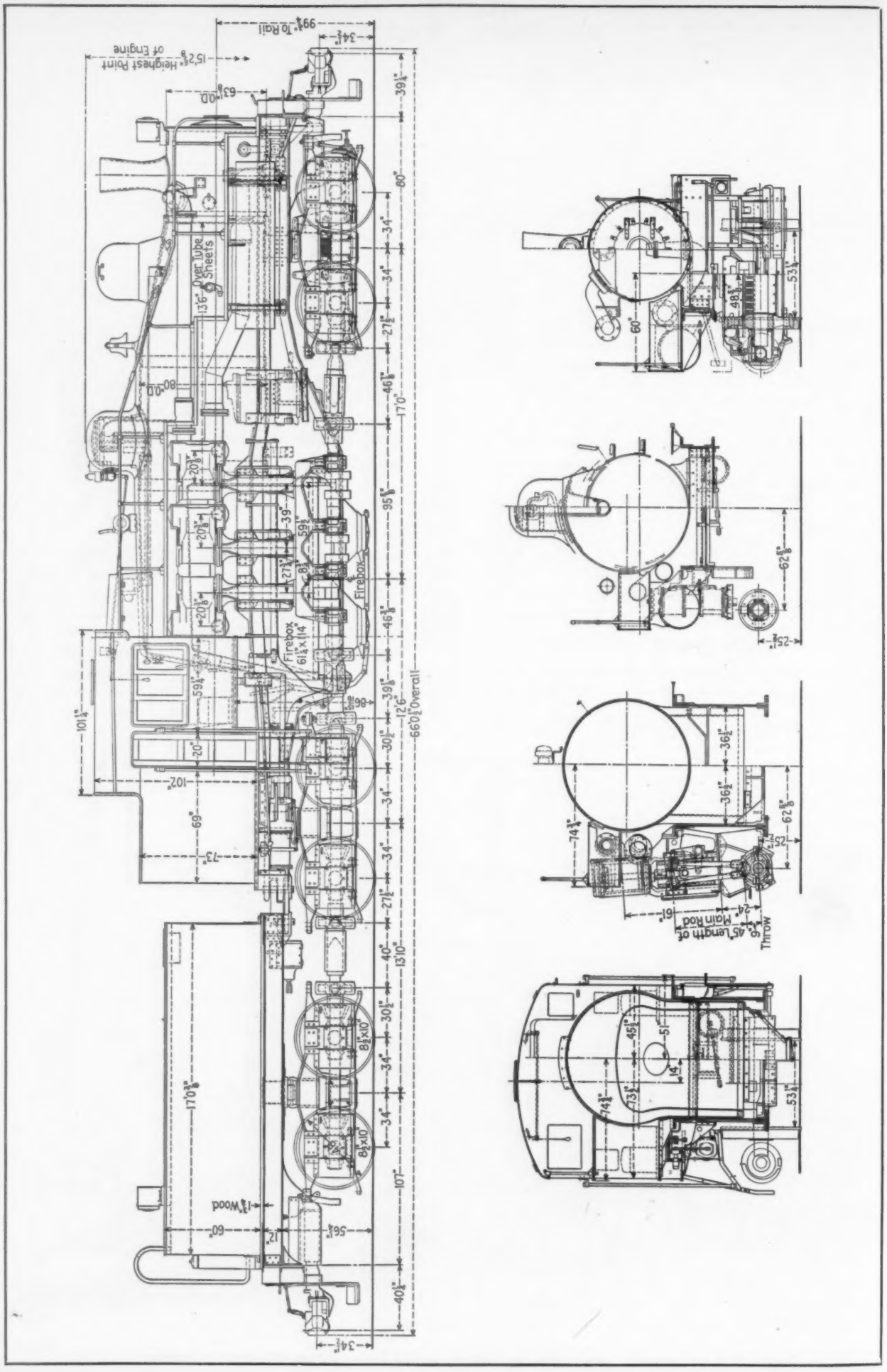
The Boiler

Conventional design and construction characterizes the boiler of this locomotive. It is a two-ring extended wagon top type, 28 ft. 3 in. long overall. The first of the two shell rings is 62⅜ in. outside diameter at the front tube sheet and tapers to 80 in. at the second-ring circumferential seam. The barrel plates are ¾ in. thick and the longitudinal seams are the triple-riveted butt type with the barrel plate seam welded. The dome, 29 in. inside diameter, is located on the second ring.

For regular operation on seven per cent grades, the fireboxes are built with a 30-in. space between crown and roof. Double water glasses are used with the low reading 3½ in. above the highest point of the crown and the high reading 21 in. above that point.



Right side of the locomotive showing the three-cylinder vertical engine and the drive shaft arrangement



Elevation and cross-sections of the Western Maryland Shay geared locomotive

General Dimensions and Weights of the Western Maryland Shay Locomotive

Builder	Lima Locomotive Works
Date built	1945
Road number	6
Steam pressure, lb. per sq. in.	200
Drivers, diameter, in.	48
Cylinders, number, diameter and stroke, in.	(3) 17 x 18
Rated tractive force, engine, lb.	59,740
Valve gear, type	Stephenson
Valves, piston, diameter, in.	9
Maximum travel, in.	4¾
Steam lap, in.	1
Exhaust clearance, in.	Line and line
Lead, in.	¼ at 50 per cent cut-off 1/16 in full gear
Cut-off in full gear, per cent	81.4
Dimensions:	
Height, rail to top of dome, ft.-in.	15—2⅝
Height, rail to center of boiler, ft.-in.	8—3¾
Width overall, ft.-in.	11—4
Length over engine and tender, ft.-in.	66—0½
Wheel bases, ft.-in.:	
Driving	49—0
Engine, total	35—2
Engine and tender, total	49—0
Truck wheel base, rigid	5—8
Weights, lb.:	
Drivers	324,000
Engine, total	324,000
Weight on drivers, per cent weight of engine	100
Weight on drivers ÷ tractive force	5.42
Tender:	
Style or type	Rectangular
Water capacity, U. S. gal.	6,000
Fuel capacity, tons (in cab)	9

The firebox is built without a combustion chamber and is 114 in. long by 61¼ in. wide inside. The side and roof sheets, as well as the furnace crown and side sheets, are each one piece and the firebox seams are riveted. The furnace door sheet and back head are welded at the door ring.

Flannery flexible staybolts are used in the firebox breaking zones and the outside row of throat sheet stays. Several rows of Flannery rigid hollow stays are used in the area above the mud ring and fire line. Three 3-in. arch tubes support the Security brick arch. Bituminous coal is hand fed through a Franklin No. 8A firedoor.

The boiler is equipped with two Sellers No. 10½ injectors having a combined capacity of 7,900 gallons per hour, Type A superheaters, 2-in. Okadee blow-off cocks, and two 3-in. Ashton safety valves.

The main steam pipe from the header to the engine cylinders is located outside the boiler on the right side and is of cast iron with ball joints. The throttle dry pipe is similarly equipped. The engine exhaust pipe is located next to the boiler on the right side and enters the smokebox on the bottom center line.

Frames and Machinery

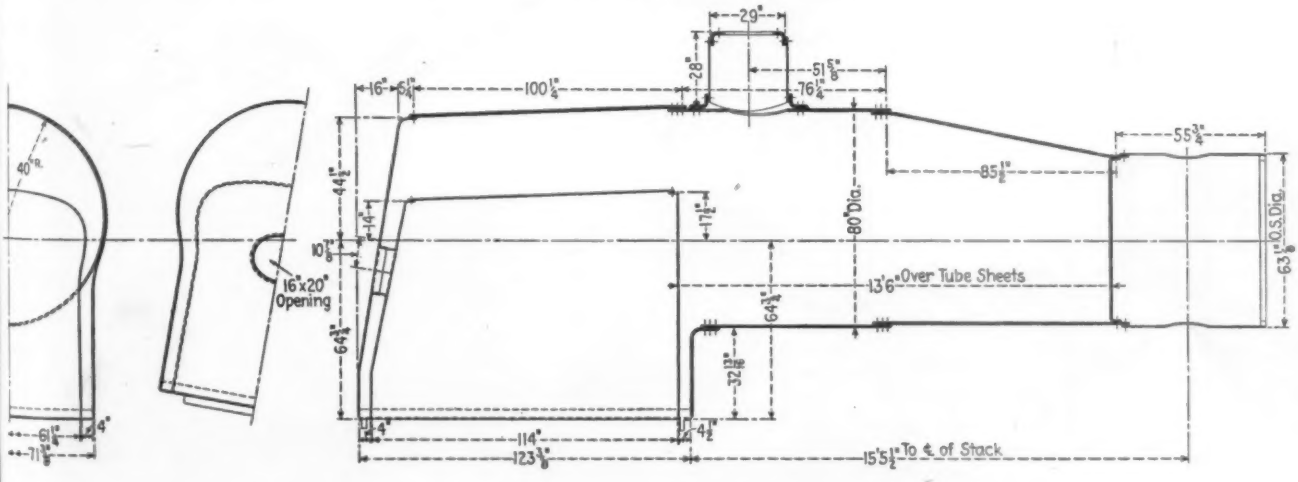
The main locomotive frame is a girder type assembly fabricated, by riveting, of plate and angles. The top rail is a 6-in. by 8-in. by 1-in. angle and the bottom rail is built up of two 6-in. by 6-in. by 1-in. angles with a 1-in. cover plate. The vertical web is ¾-in. plate on the right frame and ⅝ in. on the left frame. The side frame rails are tied together by the bumper and foot plate crossties as well as cross members at the front truck bolster and at the front of the firebox. Brackets for runboards, air compressor and air reservoirs are bolted to the frame. The center line of the boiler is located 14¾ in. to the left of the center of the track rails. This compensates for the machinery location on the right side of the locomotive.

The machinery and running gear consists of a three-

Hauling Capacity of 150-Ton Shay Locomotive

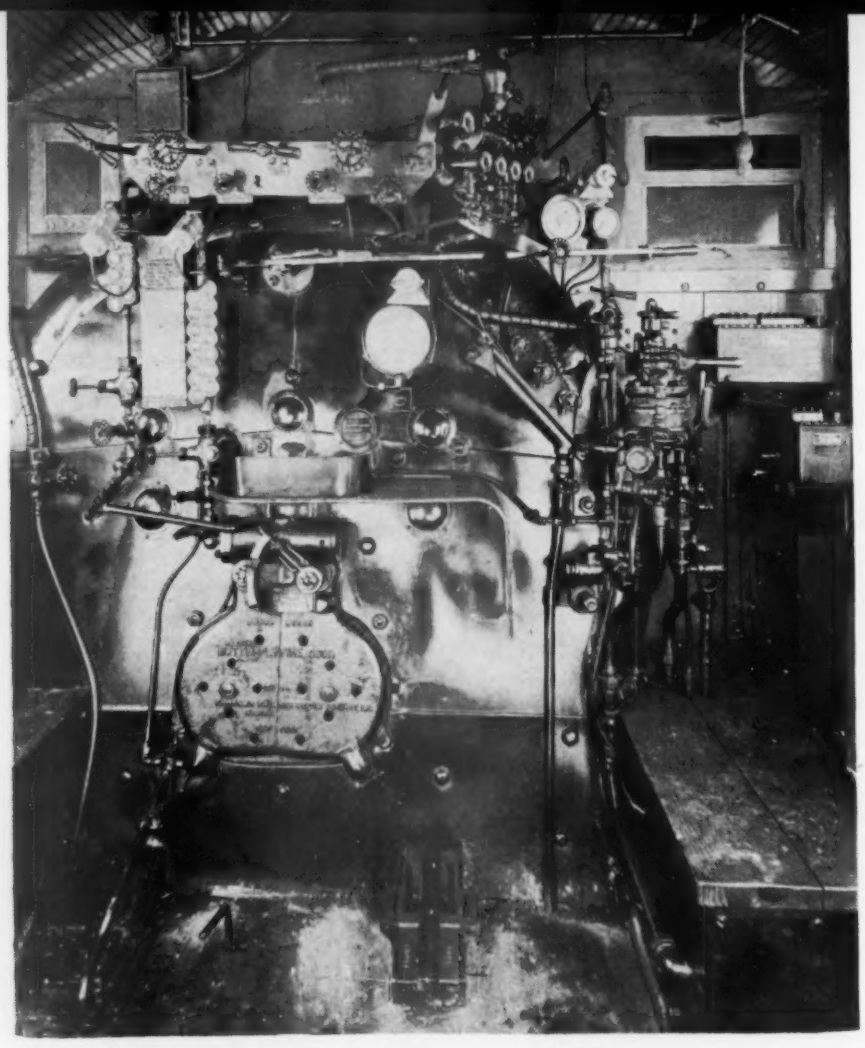
Speed, m.p.h.	Tractive force	Drawbar pull, lb. on level	Drawbar pull, lb. 5 per cent grade	Drawbar pull, lb. 7 per cent grade	Hauling capacity, tons on level	Hauling capacity, tons 5 per cent grade	Hauling capacity, tons 7 per cent grade
2	59,740	58,940	43,540	37,540	7,370	404	254
4	59,000	58,200	42,000	36,800	7,280	396	249
6	56,800	56,000	40,600	34,600	7,000	376	234
8	50,900	50,100	34,700	28,700	6,260	322	194
10	45,300	44,500	29,100	23,100	5,560	270	156
14	35,400	34,600	19,200	13,200	4,330	178	89
18	28,400	27,600	12,200	6,200	3,450	113	42
20	25,500	24,700	9,300	3,300	3,090	86	22
22	23,200	22,400	7,000	1,000	2,800	65	7

General Dimensions of the Boiler

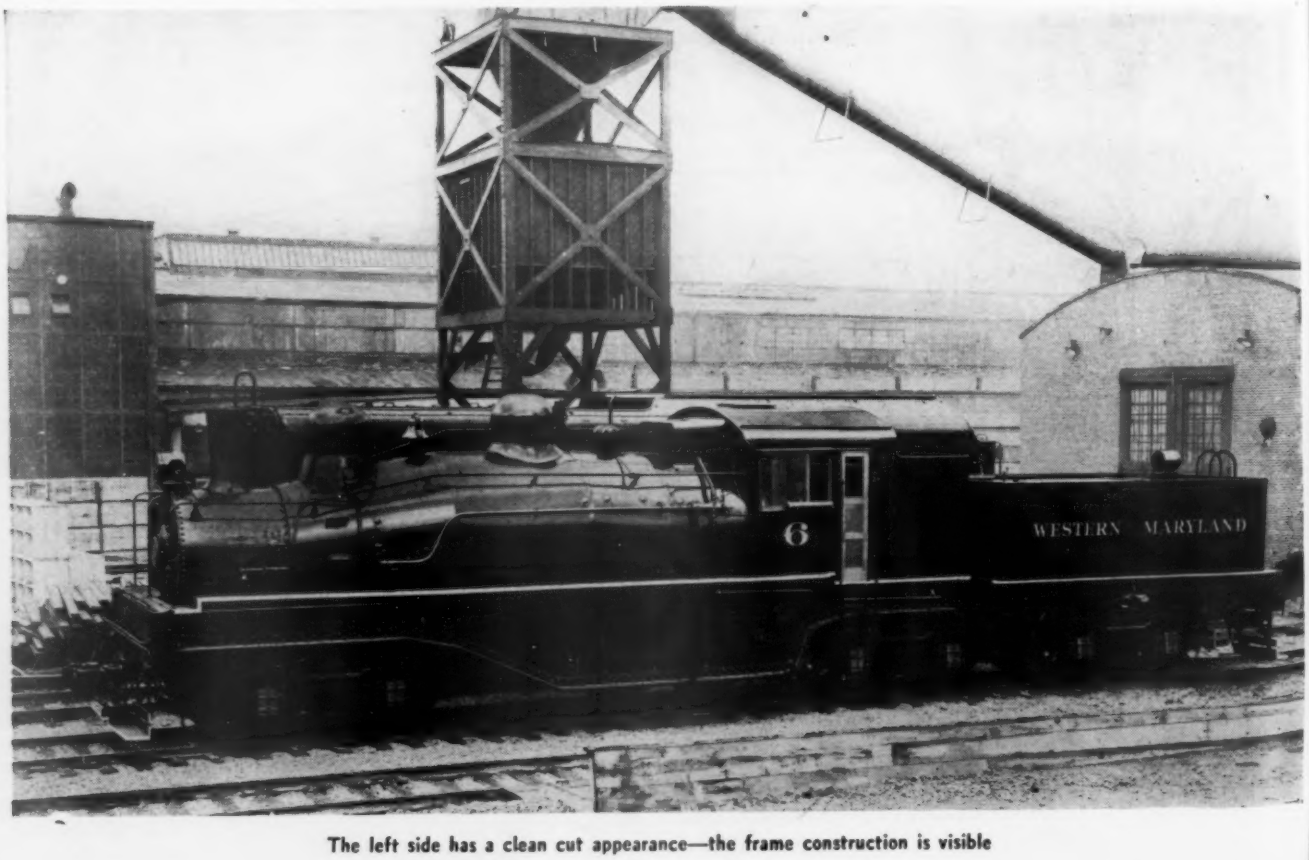


Steam pressure, lb.	200
Diameter first ring, outside, in.	Conical 62⅜ min.
Diameter second ring, inside, in.	78½
Diameter second ring, outside, in.	80
Sheet thickness, in.:	
Smokebox	5/16
First ring	5/16
Second ring	5/16
Back head	5/16
Side sheets	11/32
Roof sheet	11/32
Furnace door sheet	5/16
Furnace side sheets	5/16
Furnace crown sheet	5/16
Combustion chamber	None
Front tube sheet	9/32
Back tube sheet	½

Firebox length, in.	114
Firebox width, in.	61⅛
Water space, front, in.	4½
Water space, back, in.	4
Water space, sides, in.	4
Arch tubes, number and diameter, in.	(3)—3
Tubes, number and diameter, in.	(156)—2
Flues, number and diameter, in.	(28)—5⅜
Length over tube sheets, ft.-in.	13—6
Superheater, type	A
Fuel	Bituminous
Grate area, sq. ft.	48.5
Heating surfaces, sq. ft.:	
Firebox and arch tubes	226
Tubes and flues	1,623
Evaporative, total	1,849
Superheater	429
Combined evap. and superheat.	2,278



The cab affords plenty of working room and is of the vestibule type

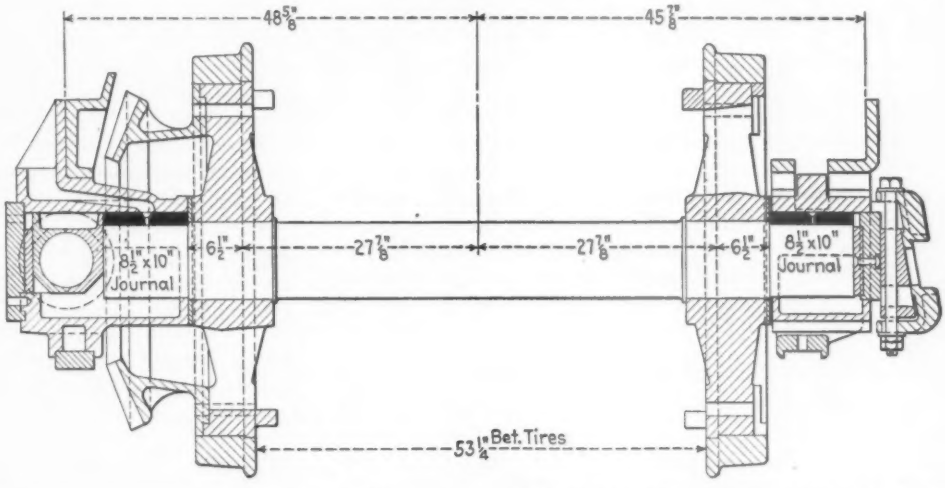


The left side has a clean cut appearance—the frame construction is visible

cylinder, single-expansion engine located on the right side immediately ahead of the cab. Directly connected to the engine crank shaft is a line shaft assembly which transmits power to three four-wheel trucks, alike in essential details and dimensions. Two of the trucks are located under the locomotive, on centers of 29 ft. 6 in., and one under the tender 13 ft. 10 in. back of the center of the rear engine truck.

The Three-Cylinder Engine

The engine is a vertical three-cylinder single-expansion unit with piston valves and Stephenson valve gear. The cylinders are 17 in. bore and 18 in. stroke. Steam distribution is effected by 9 in. piston valves operating in bushings with a 4¾-in. maximum travel. The valve gear is controlled by an Alco Type G power reverse gear through



Cross section of one of the truck wheels showing the journal bearings, line shaft bearings and the mounting of the driving gear on the steel-tired wheel

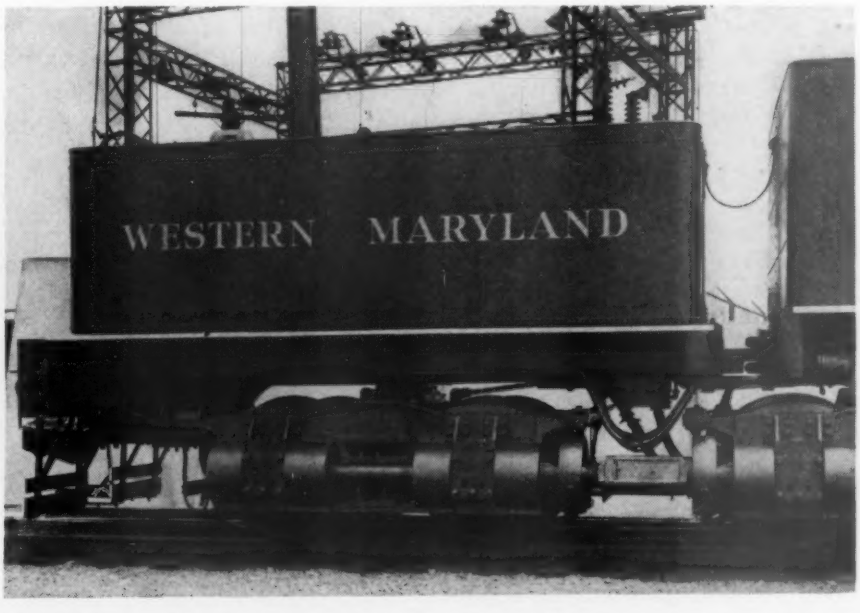
Partial List of Materials and Equipment on the Western Maryland Shay Locomotives

Firedoor	Franklin Railway Supply Co., Inc., New York.
Couplers	W. H. Miner, Inc., Chicago.
Brake Equipment	Westinghouse Air Brake Co., Wilmerding, Pa.
Gage cocks; lubricators; whistle	Nathan Manufacturing Co., New York.
Blow-off cock	The Okadee Co., Chicago.
Steam gage	Ashcroft Gauge Div., Manning, Maxwell, & Moore, Inc., Bridgeport 2, Conn.
Safety valves	Ashton Valve Co., Boston, Mass.
Water glass	Hanlon Drifting Valve Co., Boston, Mass.
Power reverse gear	American Locomotive Co., New York.
Lubrication	Manzel Bros. Co., Buffalo 10, N. Y.
Superheater	The Superheater Co., New York.
Brick arch	American Arch Co., Inc., New York.
Staybolts	Flannery Bolt Co., Bridgeville, Pa.
Injectors and checks	Wm. Sellers & Co., Inc., Philadelphia, Pa.
Headlight; generator	The Pyle-National Co., Chicago.
Bell ringer	U. S. Metallic Packing Co., Philadelphia, Pa.

double reverse cranks located in planes at right angles to each other. The reverse shaft bearings are embodied in the vertical engine frames.

The pistons are cast iron with 3½-in. hammered-steel rods secured by a taper fit to cast-steel crossheads operating in cast-iron guides in the engine frame. The forged connecting rods have brasses with two babbitt strips in each half and are adjustable at both crosshead and crank shaft ends. The crank shaft is 7¼ in. in diameter with 7¼-in. by 7-in. journals. The shaft is supported by four main bearings in the bed plate with removable bearing caps and brass bearings.

The backbone of the engine assembly is a steel bed casting to which three separate vertical engine frames containing the crosshead guides are bolted. The lower ends of these vertical frames are flanged to form the pads of the bed connection and the upper ends are flanged for the cylinder connection.



The tender tank is supported at two points—The truck and the hinge connection to the engine

On each vertical engine frame is a cast-steel valve-motion support containing the valve crosshead guide. These valve-motion supports are bolted to the side members of the vertical engine frames and act as strength members.

The cylinders and piston-valve chambers are cast as integral units and may be removed separately from the vertical engine frames. Both the engine bed plate and vertical frames are rigidly bolted to the locomotive girder frame at the top and bottom frame rails.

The line shaft which transmits power to the trucks has three pairs of universal couplings; one pair between the tender and rear engine truck; one pair between the rear engine truck and the rear of the engine crank shaft, and one pair between the front of the engine crank shaft and the front engine truck. Each coupling consists of two forked ends, or horns, forming a universal joint. The horn ends operate in bushings in the coupling ring. Removable cellars containing oil fittings are used at the four horn ends. Slip joints of square cross section, between each pair of couplings, permit truck swing adequate to negotiate 22-deg. curves. The horn couplings are cast steel, shrunk on and keyed.

Trucks and Drive Mechanism

The three four-wheel trucks have cast-steel side members and forged truck-box binders. At each truck there are body and truck bolsters consisting of a pair of 12-in. 40-lb. channels with 1⅛-in. cover plates. Coil springs, 36 in number, between the bolsters, carry the load.

Six of the 12 truck wheels, on the right side, have cast-steel wheel centers of special design to accommodate the rim of the drive gear on the outside of the wheel and with lugs cast on the inside to prevent shearing the gear holding bolts in case of derailment. Steel tires are shrunk onto the wheel centers. The six left-side wheels are rolled steel. All wheels are 48 in. diameter and are mounted on carbon steel axles with 8½-in. by 10-in. journals running in oil-lubricated bronze-bearing truck boxes. The truck boxes on the right side are a special design which incorporates both the journal bearings for the axles and the bearings for the pinion, or line shaft. These are at right angles to each other. The line shaft bearings are 6½ in. by 14 in. The pinions are located ahead of each axle and are keyed to the line shaft. The gear ratio is 2.45 to 1 with 20 teeth on the pinion and 49 teeth on the gear. The maximum locomotive speed is 22 m.p.h. at a maximum engine speed of 377 r.p.m.

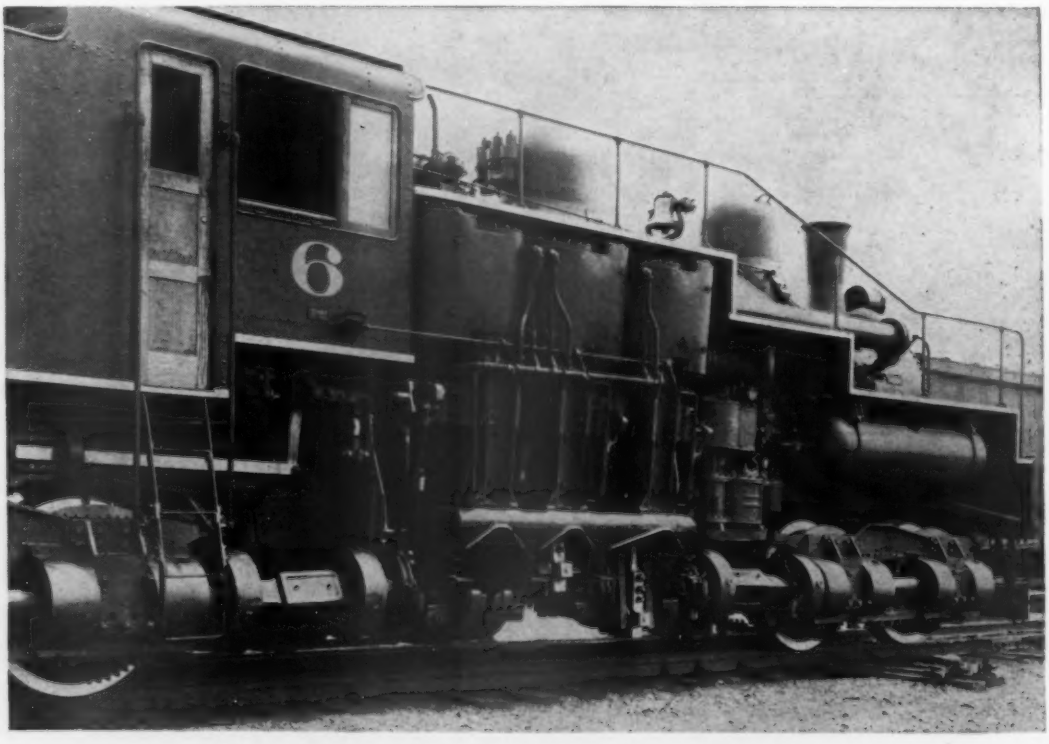
The cab is the vestibule type, of riveted construction. The cab and the coal space, having a capacity of nine tons, are built as a unit and are 6 ft. 10¼ in. long. There is approximately 5½ ft. between the firedoor and coal gates. The cab width is 119 in.

Lubrication is effected by means of two Manzel oil pumps, one a three-feed unit for the engine steam chests and the other a 10-feed unit for the engine guides and bearings. A Nathan four-feed, four-pint automatic sight-feed oiler is located in the cab.

The locomotive is equipped with Westinghouse Schedule ET-6 air brakes having a single 8½-in. cross compound compressor and one 24½-in. by 102-in. main reservoir located under the runboards on the right side.

The tender tank is mounted on a structural frame having sills 12 in. deep. The rectangular tank is 17 ft. 0⅜ in. long, 60 in. deep and 125½ in. wide; it has a capacity of 6,000 gal. The tank is built with 3/16-in. side sheets and ¼-in. bottom sheets.

The tender is supported on a single four-wheel truck and stability is maintained by a hinge connection between engine and tender consisting of a double jaw casting on the rear of the engine frame into which a rigid bar, riveted to the tender frame, and a conventional drawbar are inserted. A drawbar pin in the engine frame casting passes through both bars. The inner surface contours of both the male bar casting and the engine frame casting are such as to allow for considerable movement between engine and tender on vertical curves.



The engine and drive shaft are on the right side of the locomotive

M.B.M.A. Studies

Water Treatment Benefits*

Operating and maintenance savings resulting from water treatment and improvements that can be made to better locomotive boiler performance

THE crucible of war puts the ultimate test to the peacetime practices of all essential industries. During the years of peace we go through a period of experimentation and development. Then when war comes, we are able to get the final evaluation of this work because only the soundest and most productive operations survive such a test.

Water treatment on our railroads has met this test and passed with highest honors. A very large measure of credit has been given to water treatment for a major contribution to the successful operation of our railroads during the recent critical period, handicapped as we have been with a limited inventory of motive power and with a marked shortage of skilled maintenance personnel.

In making our daily inspections and doing everything in our power to keep our boilers operating without undue delays for maintenance, washing, or other causes, we are the first to see the benefits of water treatment. Old timers know the difficulties experienced with bad water which taxed ingenuity to the utmost in spite of a tremendous amount of hard work expended to keep boilers operating in those early days. Our association has reported on the results of water treatment from year to year since its inception and we feel it fitting and proper to continue to do so as we are in a particularly advantageous position to assess its value, since our work is in the front line of locomotive maintenance.

Water treatment has played such an important part in the success of our operations during the war that it deserves full publicity at this time in order to encourage expansion of the program to include all untreated water supplies and to insure full utilization of existing facilities and modernization of inadequate facilities to meet present requirements.

The simplest approach to an understanding of what water treatment does would be to determine its effect on one locomotive and then to multiply the result by the number of steam locomotives in service. Basically, water treatment accomplishes the following things for each locomotive: (1) Prevents scale and corrosion on water-heating surfaces; (2) permits 30-day operation for each washout, thus increasing availability; (3) maintains high thermal efficiency, thus saving fuel; (4) reduces maintenance, thus saving skilled labor and critical materials, and (5) controls steam quality.

This oversimplified form of procedure would establish savings that are truly remarkable, but actually it would not do justice to the subject as the introduction of water treatment brought about fundamental changes in railway operation which have in a large measure been responsible for making possible the high utilization of locomotives and, incidentally, made it possible for railroads to use the high-power steam locomotive itself.

During the first world war railroads generally operated their locomotives over one division only, or about 100 miles. For many years freight locomotives made an average of 3,200 miles per month and passenger engines 4,000 miles per month; shopping for flues was common practice at from 45,000 to 65,000 miles in average water territory and in bad-water territory the mileage was much lower. Without water treatment even these repairs did not eliminate trouble as flues would leak almost every trip and it would often require a boiler maker and helper six to eight hours to caulk.

It is a matter of simple calculation to prove that if such conditions had existed during World War II and if the work produced per month per locomotive had been the same as in the first world war we would have needed over 80,000 locomotives, an increase of some 40,000 units over our actual inventory. Had it been necessary to buy this additional power it would have cost several billion dollars, taken several years' time to build, and the manpower that would have been used making these locomotives could not have been used to make battleships, tanks, aircraft, and all the other tools of warfare.

Fortunately, this problem did not exist because of greatly improved operations.

Effect on Locomotive Operation

During the early twenties the idea of greater utilization of locomotives was advanced. Experiments were conducted in extending locomotive runs over more than one district. The principal objection to be overcome was the matter of boiler maintenance. Many boiler makers believed that it was absolutely necessary to either change the water or wash the boilers after each round trip, and this was undoubtedly true under existing conditions. It was found, however, that by introducing correct water treatment, the installation of proper blow-off equipment, and proper supervision of both of these factors, it was entirely feasible to extend locomotive runs almost without limit insofar as the boiler was concerned. Certain adjustments had to be made in grates, ash pans, and terminal facilities where coal was used as fuel, and these developments went forward simultaneously. The net effect was that, by the late 1930's, practically all railroads were successfully operating their power over as many divisions as their physical limitations permitted. Several very important benefits were derived from this one development.

First, each locomotive was able to operate three to five times the mileage per month. Therefore, the railroads could get the maximum use out of their latest and most improved locomotives and were enabled to scrap their oldest and less efficient smaller power.

Second, where one locomotive could do the work of five or more previously used on a certain run, the result was that terminal fuel consumption was dractically reduced. Standby losses due to having a number of units fired up to handle a certain train together with the inevitable protection units held in readiness were indeed

* Paper prepared for 1945 year book of the Master Boiler Makers' Association.

sizeable. These losses were largely eliminated by extended runs.

Third, with increased utilization assured, railroads could well afford to invest a great deal more capital in each new locomotive purchased to get greater power per unit and to utilize the latest developments in economy devices. As a result, locomotives were purchased and put to work, costing five to ten times as much per unit as had been expended heretofore, and these units developed correspondingly greater horsepower, enabling them to move more cars over the railroad at high speed with greatly reduced cost of operation. The railroads rapidly took advantage of this new possibility and new power was purchased which could not have been economically employed prior to the development of the long-run principle.

With every extension in locomotive operation and with every new locomotive purchase, water treatment became more vital and has been handled accordingly. Testing equipment (illustrated) has been developed that

Dearborn water-testing laboratory for terminals

permits ready determination of the condition of the boiler water in each locomotive both on arrival and departure from important terminals, something that had not been considered feasible before but which has become a prime requisite at all important locomotive terminals in recent years. Personnel has been trained to handle this testing and control program and this work has paid big dividends in improved performance and in helping to increase the availability of the power.

A complete water treatment program does the following major things with many subdivisions under each one: (1) Individually treats each water supply to render it non-scale forming and to prevent pitting and corrosion difficulties. The treatments are of such nature as to prevent incrustation of all underground pipe lines and of boiler checks, branch pipes, and locomotive injectors; (2) establishes a schedule of road and terminal blow-down to keep the boiler water in proper condition so as to permit 30-day operation for each washout, and (3) provides proper control facilities and personnel to check the operation of the treating plants and the boilers on a regular schedule. In addition, since full benefits of the water-treatment program cannot be obtained unless every factor in boiler operation is kept in tune with best possible practice, the water-treatment engineer follows the boiler into the enginehouse and interests himself in seeing to it that proper practices are followed in every step from blow-down right on through boiler-washing operations and firing up.

While great advances have been made in improving locomotive boiler performance, much still remains to be accomplished. It is generally considered desirable to operate boilers 30 days for either a water change or a washout. Many roads are getting these benefits, but quite a few fail to do so either through insufficient supervision of blow-down or possibly due to lack of understanding and application on the part of the supervising forces of the benefits that can be obtained through proper attention to this problem. Old-fashioned prejudice is responsible in some cases and should be guarded against by critical self analysis to the end that the best and most efficient operation is obtained in every instance.

An important feature of doing the job less frequently is to do it well when it is done. This requires conscientious washing and supervision at the scheduled washout times and the correct tools and facilities to do the work thoroughly.

Washout openings must be located properly, suitable washout nozzles must be available together with instructions for their use, and adequate water pressure is essential. The boilers must be cooled down prior to washout to minimize stress and at the same time avoid possibility of sludge or mud baking onto exposed hot, dry surfaces of the tubes and sheets. The cool-down method of boiler washing has been reported several times in our proceedings and we recommend it for further consideration.

Water treatment has made a remarkable record of savings during the war years. In 1944, according to the thirty-third annual report of the director of the Bureau of Locomotive Inspection, 1,302 time extensions were granted in the removal of flues which is indicative of the effect of water treatment because these extensions could not have been granted if the flues had not been clean. This represents a continuation of the improved conditions reported in detail in our proceedings of 1941.

Material Savings

Much critical material has been saved for other uses by water treatment. C. R. Knowles, former superintendent of water service of the Illinois Central, retired, in an article on water treatment in the April 24, 1943, issue of the Railway Age stated: "The flues in a typical locomotive containing 119 2¼-in. flues and 30 5½-in. superheater tubes, all 19 ft. 6 in. long, weigh 11,438 lb. In addition, a firebox with 185 sq. ft. of heating surface, constructed of ⅜-in. steel, weighs 2,832 lb., making a total of 14,270 lb. of steel in flues and firebox.

"Sixty such locomotives might reasonably operate in one treated-water district, representing 856,200 lb. of material directly affected by water treatment. Having established that the life of flues and tubes will be increased from 5 to 15 years, there is a saving in this material over a 15-year period of 1,327, 560 lb., or 91,504 lb. per year.

"Doubling the life of fireboxes from 10 to 20 years represents a 20-year saving in material of 169,920 lb., or an annual saving of 8,496 lb. Thus, the combined saving in flues and fireboxes is 100,000 lb. per year for a typical group of locomotives operating on completely treated water.

"The weight of tubes and flues in one of the largest locomotives in service is 32,586 lb., or 1,955,160 lb. for

a group of 60. Trebling the life of flues and tubes will effect an annual saving of 146,344 lb. over a 15-year period. The firebox of this locomotive weighs 19,500 lb., representing 1,170,000 lb. for the 60 locomotives. Doubling the life of fireboxes will save this material every 20 years, or an annual saving over the 20-year period of 53,400 lb. The combined saving each year is 199,744 lb. in flues, tubes and firebox sheets without counting staybolts and the thousands of man-hours of labor made available for other work."

These figures indicate the savings in critical materials and skilled labor that has been effected through the water-treatment program.

According to latest available figures by Railway Engineering and Maintenance Cyclopedia, our locomotives use some 437,000,000,000 gal. of water each year. It is estimated that 44 per cent of this water, or some 200,000,000,000 gal., is being treated in full or in part, thus removing or making harmless more than 220,000,000 lb. of scale annually, saving about $29,000,000 per year on the basis of 13 cents per pound of scale. The same source states that treatment is being used at 5,000 water stations and that there are 8,250 additional stations at which water treatment could be used with economy to our roads.

We feel that the savings usually reported at the old 1924 A.R.E.A. figure are entirely too low and that if this figure were to be brought up to date, it would be helpful in expediting the completion of the water-treatment program. The present 13-cent figure gives ample savings in most instances to justify treating-plant installations, but it is so far below the true savings it may well be that sufficient urgency is not presented to management to place the proper emphasis on this work.

Based on published index figures by the A.A.R., the 13-cent-per-pound savings could be increased as follows. Using the cost in May, 1933, as the basis or 100, the cost of fuel in December, 1944, was 185.1 and other material and supplies 162.4. Using 1918 labor cost as 100, 1942 labor cost is given as 185.

A rough calculation would indicate a minimum weighted increase of 75 per cent in the costs that enter into the A.R.E.A. formulae, which, on this basis, would justify a minimum saving of $1.75 \times 13 = 22.75$ cents per pound of scale-forming materials neutralized in our water supplies today. Use of this figure in calculating savings should be of great help in compelling attention to the truly wonderful savings to be realized by treating all remaining raw water supplies.

The really clean boilers made possible by water treatment have opened the way for the railroads to realize the economy of higher pressure design which would have been impossible without scale elimination through treated water. The fact that high-pressure boilers are more susceptible to maintenance occasioned by poor water has emphasized the necessity of strict control over the existing water treatment and all boilers have benefitted accordingly.

There should be a word of caution, however, against allowing the theoretical design of high-pressure boilers to ignore the practical aspects of railroad operation. New designs should allow adequate steam space, provide for complete water circulation without steam or mud pockets, and have facilities for really effective blow-down. Finally, the question of easy and complete washing must not be overlooked. In the matter of general boiler construction, the intercrystalline corrosion studies carried out in both public and private laboratories with the cooperation of the railroads for the purpose of creating better water treatment have pointed the way to better locomotive boiler structures. It has been shown that overstressing of seams through poor fittings or careless workmanship is a basic factor in the cracking of rivets and sheets which has been blamed on the intercrystalline corrosion tendencies of certain untreated or improperly treated waters. The importance of keeping seams tight to avoid future heavy repairs has also been brought to light and the great advantage of the all-welded boiler over the riveted boiler has been emphasized. We anticipate further developments along this line with the use of a good many welded boilers in the near future.

Attention has been focused on developments in better steel for boiler purposes and new alloys are under intensive study by a western railroad whose research laboratory has taken a broad interest in water treatment.

A recent ramification showing the importance of the treatment of railroad water supplies has developed in the maintenance of engine-cooling systems and passenger train steam-heat generators on Diesel power. Contrary to the original belief that Diesel power could ignore the quality of its water supplies, the intricacy of these machines and the flash-boiler type of steam generators carried in their restricted space has developed water troubles requiring even greater care than the steam locomotive. Water treatment has risen to the demand where established types of treatment have been inadequate and new special treatments have been devised, even to the extent of providing demineralized water with new types of synthetic zeolites and a following treatment to avoid corrosion.

Nalco laboratory for terminal water testing

Advantages Summarized

In summarizing, we can unequivocally state that the water-treatment program has done the following things for our railroads: (1) Made possible long runs of steam locomotives; (2) permitted use of high-power locomotives; (3) reduced fuel consumption (steam locomotive use has improved by over 50,000,000 tons per year based on work performed according to A.A.R. figures); (4) saved the railroads not less than $30,000,000 annually; (5) during each war year saved a substantial tonnage of steel; (6) contributed very largely to the high avail-

(*Continued on page 579*)

Fuel Records and Statistics

A review of 1945 revisions in I. C. C. Form OS reports by the Railway Fuel and Traveling Engineers' Association Committee on Fuel Records and Statistics—Other shortcomings are pointed out in a report for the Association's 1945 year book

THE report of your committee for the year 1940 covered in some detail certain features of Form OS reports to the Interstate Commerce Commission and the year 1941 report continued this discussion. The 1941 report dealt specifically with Coal Equivalents and the various methods of procedure for their determination, recommending certain limiting conditions. These limitations were tabulated and a comparison made with the practices of 30 Class I railroads in making their reports to the Commission. In 1941 a committee was appointed to "take appropriate action to determine the possibility of obtaining the publication of more detailed fuel statistical reports for Class I railways than have been made available for general distribution." A progress report of this committee was submitted to the full membership of the Railway Fuel and Traveling Engineers' Association. As a result of the work of this committee and excellent cooperation on the part of the A.A.R. Accounting Division Committee on Statistics, certain additions were made on Forms OS-A, OS-B and OS-E, effective January 1, 1945. The following is a tabulation of these additions.

Additions to Form OS-A—Freight-Train Performance

2—TRAIN MILES:
- 2-01—Steam locomotive propelled trains
- 2-02—Diesel-electric locomotive propelled trains
- 2-03—Electric locomotive propelled trains
- 2-04—Other locomotive propelled trains
- 2-05—Total locomotive propelled trains

3—ROAD LOCOMOTIVE-MILES:
- 3-06—Total, Diesel-electric only

Train-switching:
- 3-10—Diesel-electric locomotives
- 3-14—Miles at initial and final terminals included in total (item 3-13)

5—GROSS TON-MILES OF ROAD LOCOMOTIVES AND TENDERS (THOUSANDS):
- 5-03—Diesel-electric locomotives

6—GROSS TON-MILES OF CARS, CONTENTS, AND CABOOSES (THOUSANDS):
- 6-03—Total in Diesel-electric locomotive trains

8—TRAIN-HOURS (INCLUDING TRAIN-SWITCHING HOURS AT WAY STATIONS):
- 8-01—Steam-locomotive-propelled trains
- 8-02—Diesel-electric-locomotive-propelled trains
- 8-03—Electric-locomotive-propelled trains
- 8-04—Other-locomotive-propelled trains
- 8-05—Motor-car-propelled trains

Additions to Form OS-B—Passenger-Train Performance

2—TRAIN-MILES:
- 2-01—Steam-locomotive-propelled trains
- 2-02—Diesel-electric-locomotive-propelled trains
- 2-03—Electric-locomotive-propelled trains
- 2-04—Other-locomotive-propelled trains

3—ROAD MOTIVE-POWER MILES:

Locomotive-miles:
- 3-06—Total, Diesel-electric only
- 3-08—Total, other (Diesel and gasoline motor and gasoline electric)
- 3-10—Train switching miles, Diesel-electric locomotives only
- 3-12—Train switching miles, other locomotives

5—TRAIN-HOURS:
- 5-01—Steam-locomotive-propelled trains
- 5-02—Diesel-electric-locomotive-propelled trains
- 5-03—Electric-locomotive-propelled trains
- 5-04—Other-locomotive-propelled trains

Additions to Form OS-E—Fuel and Power for Locomotives and Rail-Motor Cars

2—QUANTITIES OF FUEL AND POWER CHARGED TO YARD AND TRAIN ACCOUNTS:

Quantities consumed in road freight service (Accounts 394, 395 and 396):
- 2-10—Diesel fuel (gallons)
- 2-12—Gasoline (gallons)

Quantities consumed in road passenger service (Accounts 394, 395 and 396):
- 2-22—Total fuel by motor-car trains (equated net tons coal equivalent)

8—FUEL AND POWER CONSUMED PER 1,000 GROSS TON-MILES (INCLUDING LOCOMOTIVES AND TENDERS)—ROAD FREIGHT SERVICE:
- 8-03—Gallons of Diesel fuel (Diesel locomotives) (2-01 ÷ [5-03 0S-A + 6-03 0S-A])

9—FUEL AND POWER CONSUMED PER PASSENGER-TRAIN CAR-MILE—ROAD PASSENGER SERVICE:
- 9-05—Equated pounds of fuel (motor-car trains) (2-22 × 2,000 ÷ 4-21 0S-B)

The additions to Forms OS-A and OS-B listed make possible the compilation of statistics for the differently propelled trains of such items as:

X1—Passenger car-miles per passenger train-mile; i. e., average cars per train
X2—Gross ton-miles per freight train-mile; i. e., average gross tons per train
X3—Gross ton-miles per freight train-hour; i. e., average ton-miles per hour
X4—Freight train-miles per freight train-hour; i. e., average speed in m.p.h.

All of these are extremely useful in the analysis of the relative efficiency of the differently propelled trains.

Neither Form OS-A nor Form OS-B segregates the locomotive-miles (Principal and Helper) according to the differently propelled trains. For this reason the following equally important items cannot be computed:

X5—Locomotive miles (principal and helper)
X6—Gross ton-miles (excluding the locomotives and tenders) per locomotive-mile; i. e., the average gross tons per locomotive.

While items X1 to X4 can be computed from the

information now shown on Forms OS-A and OS-B, there is no provision made on either form to show this information.

As to Form OS-E, the quantities of fuel and power, item 2 (2-01 to 2-24 both inclusive) are not so segregated as to permit of computing under averages (items 7, 8 and 9) according to the differently propelled trains. In this connection, even with the additions to Forms OS-A, OS-B and OS-E, the usefulness of Form OS-E is largely restricted for the following reasons:

On Form OS-A, Gross Ton-Miles (items 5-01, 5-02, 5-03, 5-04 and 5-05) and on Form OS-B, Passenger Train Car-Miles (items 4-09, 4-10, 4-11, 4-12 and 4-13) are segregated as between *trains* of different propulsion, according to the kind of fuel used by the principal locomotive, but on Form OS-E (Fuel and Power for Locomotives) the fuel is separated by locomotives only and, therefore, it makes no provision for trains that are rather common at present; i. e., where "Diesel trains" have steam locomotives assisting or doubleheading. This, of course, results in distorted figures in the averages on Form OS-E (items 8-03 and 9-03, for example).

Notwithstanding the separations made on Forms OS-A and OS-B for items of Passenger-Train Car-Miles and Gross Ton-Miles, as between *Diesel-propelled* (principal locomotive) and Steam-propelled (principal locomotive), there is no provision made on Form OS-E to set the fuel up in the same manner, so that the road and helper fuel will follow the ton-miles, or car-miles derived from the consumption of this combined road and helper fuel.

The progressive increase in the number of Diesel locomotives on some roads in the United States emphasies the importances of statistics that will convey a picture of the relative fuel performance of the Diesel-propelled trains as compared with trains using fuel other than Diesel oil. Steam helpers are common on Diesel-propelled trains. It is evident, therefore, that a tabulation of the helper fuel by *kinds of trains* is necessary to produce fuel service units that will be comparable. It is strongly recommended that consideration be given to the revision of Form OS-E to provide for setting up the helper coal figures by *kinds of trains* so that comparable figures will be available as between railroads.

On the Baltimore & Ohio, in July, 1945, 31 per cent of the passenger-train car miles were produced by Diesel-propelled trains. Of the fuel used by Diesel-propelled trains 9.7 per cent was used by steam helpers. In freight service, of the total gross ton-miles, 2.7 per cent was produced by Diesel-propelled trains and, of the fuel used by Diesel-propelled trains, 11.3 per cent was used by steam helpers. While there were no helpers in yard service, it is interesting to note that at the four terminals that use Diesel locomotives 97.6 per cent of the yard-engine hours was produced by Diesel switchers. This figure, however, represents but 16.6 per cent of the yard engine hours produced on the B. &. O.

The committee members are E. E. Ramey (chairman), superintendent fuel conservation, B. & O.; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; J. G. Crawford, fuel engineer, C. B. & Q.; J. R. Jackson, engineer of tests, Mo. Pac.; H. Morris, superintendent fuel and locomotive performance, C. of N. J.; E. G. Sanders, fuel conservation engineer, A. T. & S. F.; W. R. Sugg, general supervisor air brakes, Mo. Pac.; W. J. Tapp, superintendent fuel conservation, D. & R. G. W.; R. J. Tucker, assistant to fuel supervisor, C. & O.

Water Treatment Benefits

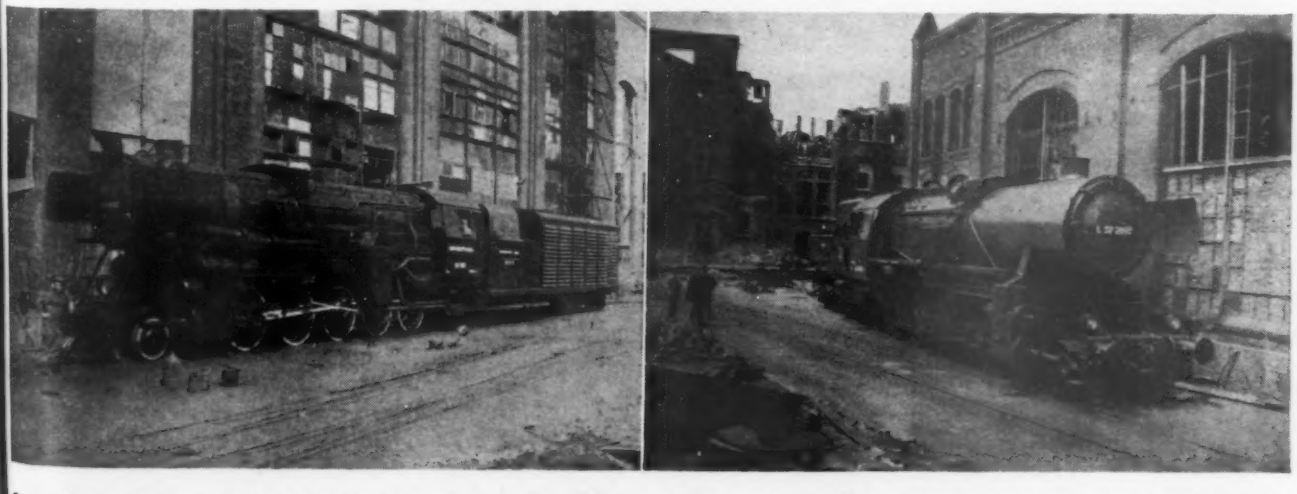
(*Continued from page 577*)

ability of steam locomotives which made it possible for about 42,000 locomotives to deliver nearly twice the work done by some 64,000 locomotives in World War I; (7) reduced shopping time of locomotives to the minimum required by machinery repairs, and (8) contributed to a performance record where boiler failures are virtually eliminated.

The record of water treatment on our railroads is one of great service. Vigilance needs to be exercised by everyone to maintain the facilities and continue to obtain the benefits of this program. Rapid extension of water treatment to all sizeable supplies is indicated and larger tenders and alteration of schedules should permit elimination of small stations which would not otherwise warrant treatment installations.

The committee consists of John P. Powers (chairman), system boiler inspector, C. & N. W.; H. L. Harrell (vice-chairman), shop engineer, I.C.; F. A. Longo, general boiler inspector, Sou. Pac.; B. C. King, general boiler inspector, Nor. Pac.; H. C. Haviland, supervisor of boilers, N. Y. C.; I. N. Moseley, master boiler maker, N. & W., and E. H. Gilley, general boiler foreman, Grand Trunk.

* * *



German locomotives repaired by the M. R. S. for use on German railways—At the left is a modern condensing-type locomotive, and at the right, a war-time non-condensing type—The photographs were received from Lt. E. D. Shain, a Reading employee then with the 757th railway shop battalion

Improving Car Shop Facilities*

Material handling an important subject for study –Fabrication and reclamation by welding of increasing interest – Best wheel shop practices must be initiated at all points

For many years the development of improved car shop facilities has been a live subject on the Delaware & Hudson. A number of years ago competitive car building contests were held annually at our freight-car repair shops. This novel plan of education was conceived to disclose the advantages that come from the use of efficient shop facilities and practices. While the contests aided in the development of the use of improved tools and methods, the important lesson we learned was the value of getting our material to a car and arranging it to effect maximum output with minimum effort, eliminating the loss of applied man hours.

Before the war, the thought had been pretty well-established that it would be necessary to eliminate some antiquated practices. Demands upon our limited shop capacity far beyond anything previously experienced came with the war. We were confronted with an acute manpower shortage and restrictions on the supply of essential materials at a time when the demands were greatest. Probably at no time in our experience were management and supervision so pressed for the development of new ideas to cope with a situation. Now that the war has ended we can all look back at the record and feel, with satisfaction, that we met the situation squarely and did a good job despite the handicaps, and out of it we have gained a knowledge that will prove invaluable with the passing of time.

The Oneonta wheel shop of the Delaware & Hudson

One of the problems that faced us, with the limited manpower available, was the handling and delivering of material in and about shops and repair tracks. New methods and practices were developed to insure that such operations could be handled with minimum delay. The problem was solved by expanding the use of mechanical devices and providing roadways over which tractors, cranes, trailers, etc., could travel to best advantage. The installation of good concrete runways took us out of the mud and put the operation of these vehicles on a firm footing. The handling of material by such modern means is no more efficient than the ground upon which it operates. Getting material from the source of supply to the car undergoing repairs is of prime importance in effecting maximum output with minimum applied man-hours.

Our first problem was to procure the equipment needed and then organize scheduled deliveries to avoid duplication of effort and idle time. Fortunately, we have been gradually adding mechanical equipment to that on hand and today we find ourselves in a rather favorable position in that we have various types of mobile units adaptable for handling material with the least human effort.

At a series of discussion group meetings attended by our supervisors, many of our problems were analyzed and suggestions offered. Some of the suggestions were adopted and proved very valuable in improving the efficiency of our shop operation. We have found that material-handling equipment can best be utilized when under the supervision of one foreman, that is, by central-

* A paper delivered before the Eastern Car Foreman's Association at New York on October 12, 1945.

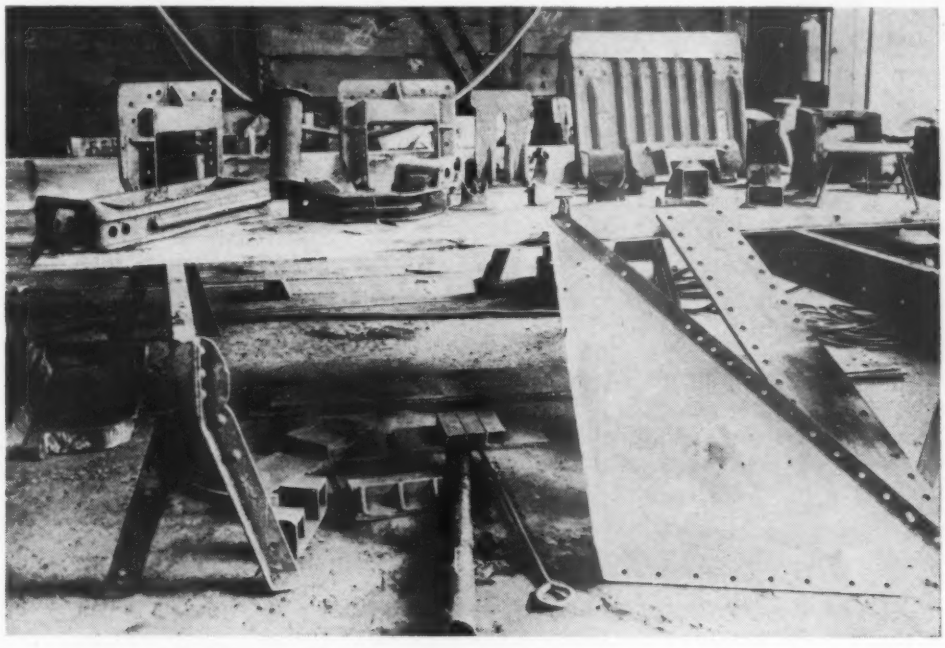
ized control. A central station established as headquarters for the material supervisor, where all other foremen can make known their requirements and from which the operation of the various machines can be scheduled, gives excellent results. Empty trips can be eliminated, duplicate trips avoided and maximum loading of machines can be secured.

Material supply and handling represents, to a large extent, the supporting labor, the labor that is required as a preliminary operation before the repair or construction is actually started, and to keep it going after it is started. If our supporting labor is not efficient, our shop operation is not efficient.

Establishing a good system is not a case merely of obtaining the equipment, furnishing good roads, good operators and supervision. Constant study and development of facts are needed whereby improvements can be made, and changing conditions recognized and corrected. This can be handled only through direct contact between the plant management, the supervision and the workmen. It requires a supervisory training program or discussion group. A discussion group was established at the Oneonta car shop and each supervisor made suggestions and recommendations that would improve the service. As a result of this a smooth-operating, efficient handling and delivery service has been established. The manual effort required in handling material has been considerably reduced and efficiency increased. This causes the heavy burden to be lifted from the shoulders of the employee and placed on the mechanical devices, where it belongs, thereby making available the service of a lot of good men to perform the actual mechanical work on the cars. The employee who has for years pushed a two-wheel wagon around the shop with heavy loads is the man who will tell you that tractors, trailers and Chore Boys have made this job easier and that, in itself, speaks for the success of this undertaking.

Servicing Material-Handling Equipment

Many thousands of dollars worth of mechanical-handling equipment creates a problem of proper maintenance and it is necessary to schedule the inspection, servicing and repairs to this equipment to avoid the possibility of the equipment becoming badly damaged from neglect and kept out of service. A tractor, Chore Boy or crane out of service due to neglect of lack of maintenance will reduce materially the value of a coordinated material-handling program. Periodical inspection reports, which in some cases are daily and in others weekly, not only serve to indicate that machines are being properly maintained but they provide a good record of the durability and the adaptability of the various machines to their jobs and make it possible to observe any of the weak points where, perhaps, there is a need for modernization.

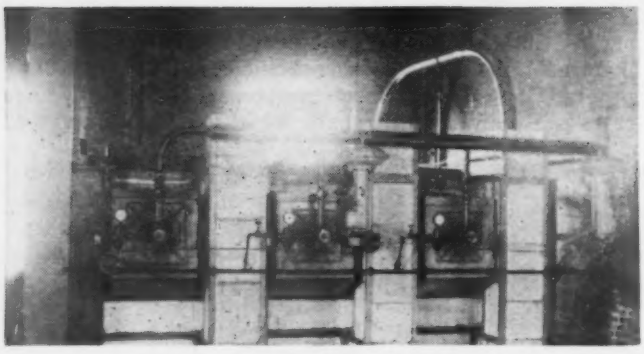


Some of the parts made or reclaimed by welding on the D. & H. during the war

Shop Supervisors Meet

Confronted as we were with the difficulties of shop operation during the war, management soon realized the value of the exchange of ideas among supervisors and the submission of suggestions and their development if they had merit. Meetings, held weekly or more often, gave each supervisor an opportunity to make known his problems and practices were developed which proved valuable during the war and will prove more valuable in the years

Some of the material-handling equipment at the Delaware & Hudson's Oneonta car shop



Temperature-regulated car-bottom furnaces are needed for proper reclamation work

to come. Two things have been accomplished, supervisors realize the value of thinking and planning, and understand each other better; and, the problems of the supervisors are brought to the attention of the management and a better understanding of procedure is obtained. The search for new methods and the development of new procedures is something that must not fall by the wayside. We will need them in the future more than ever before.

Reclamation Work

Because of economic conditions in the years before the war the reclamation of material was given very thorough study on all railroads. Methods and practices were developed to save money and the reclamation of material was a well-established practice. The reclamation of couplers, truck side frames, knuckles, knuckle locks, brake beams and many other car parts had been developed to a point where we thought we could proceed no further. We were fortunate in having this basic experience in reclamation to use and improve upon during the war years when we were confronted with the material shortage. All of us who thought we were doing a great job prior to the war can now say that we had only started. Welding methods were improved upon. Parts made from open-hearth plate and angles, fabricated, assembled on jigs and welded, were substituted for unobtainable castings. These included such parts as strikers, coupler carrier irons, draft stops, center-sill fillers and other small castings. The A.A.R. restrictions that existed on the reclamation of material were relaxed and we have learned many things about welding that we never dreamed of before. The value of this knowledge will be carried into the post-war years and result in great savings.

Installation of annealing and normalizing furnaces has made it possible to restore car parts to service with confidence that they will stand up. Furnaces regulated and controlled automatically eliminate a large part of the human element from such operations. The installation of such a furnace has been made at our main car shop with the result that the scope of our activities in reclamation has been greatly increased. The increased capacity makes it possible to normalize all truck side frames removed from cars going through the shop thereby affording better inspection and a guarantee of better service.

Straightening Stall

We have been confronted with increased damage to open-top equipment by loading and unloading machines and from other accidents. This damage is so extensive that numerous cars are rendered unfit for further service until they are repaired. Many man-hours are required to remove damaged parts from cars, straighten them and replace them. This led to the development of a straightening stall on our railroad with which you are probably now familiar through the publication of its description in the *Railway Mechanical Engineer*.* Such a straightening stall involving the use of air jacks, upright posts set in concrete, overhead hoists and runways and cross beams on which to jack, has made it possible to take some extreme cases of damaged cars and straighten them without so much as removing a rivet. Man-hour requirements are reduced to a figure that is amazing. This provides the man-hours saved to build and repair other equipment. The elimination of the cost of material and return of the car to service in a much shorter time is valuable. A car with bent sides, ends and perhaps a twisted underframe often can be repaired and returned to service within eight hours. The movement and adjusting of loads that have shifted can be accomplished in such a facility as this with one or two men, thereby avoiding load transfers or expensive hand jacking. Bent center sills that were formerly heated and straightened through the use of pulling jacks, sledges, and other methods involving considerable hard work can now be jacked back into place cold in a very short length of time. Without a doubt the straightening stall has created a method of restoring cars

TRACTOR INSPECTION REPORT

Date _____

	Flat.Elec. ET-1	Gas-Elec. ET-6	Loadmaster ET-9	Krane Kar ET-15	Krane Kar ET-16	Yale Lift ET-20
Inspected by						
Oil Changed						
Lubricated						
Tires						
Brakes						
Kind of Oil						
Battery Filled with Water						
Battery Cleaned						
Battery Insp. by Electrician						
Date Filled with Castor Oil						
Steering Mechanism						
Hoisting Mech., Cables & Hooks						
Repairs to be Made						
Repairs Made						
Remarks						
Operator's Signature						

Regular attention for material-handling equipment keeps it in best condition for service

to service within a period of time that was heretofore unthought of. Like the tractor and trailer system of delivering material, a system of repairing cars in the straightening stall has no end as to the extent to which it can be developed. The ingenuity used by workmen to save backbreaking work has no limit. The stalls are particularly adaptable to outside points and gateways and, on our railroad, each main gateway is so equipped. We have found it has been possible to reduce transfers, car delays, lading delays and backbreaking work from those small points which, at the best, are usually equipped only for light repairs.

* See *Railway Mechanical Engineer*, February, 1945, p. 75.

Wheel-Shop Practices

With the cooperation of the railroad management, the Association of American Railroads and wheel manufacturers, wheel shop practices have been improved. The A.A.R. mechanical inspections have brought home, directly to the wheel-shop foreman and the machine operators, the necessity for more accurate and painstaking machining of car axles and wheels. The Wheel Manual has illustrated very vividly what is required and, in addition, has told why it was required. The mechanical inspectors that visited the various wheel shops were men

CHORE BOY INSPECTION REPORT

Date _____

	Chore Boy ET-18	Chore Boy ET-19	Chore Boy ET-21	Chore Boy ET-22	Chore Boy ET-23
Inspected by					
Oil Changed					
Lubricated					
Tires					
Brakes					
Kind of Oil					
Steering Mechanism					
Repairs to be Made					
Repairs Made					
Remarks					
Operator's Signature					

Chore Boys are inspected and serviced at scheduled intervals

of experience who could talk shop language in such a way that full benefit was obtained in educating the employee.

Probably a large percentage of hot-box troubles can be traced, directly or indirectly, to poor wheel-shop practice. The methods now established for a periodical checking of all wheel-shop machinery is one of the great steps that has been taken to insure proper wheel-shop work.

For years we have trued journals that have been overheated excessively. Visual inspection was about all that the journals received to discover cracks. Dependence was placed largely upon the operator of the journal lathe to discover such defects while taking the cut. The use of Magnaflux testing through which such defects as seamed journals and wheel seats are found has made it possible to remove dangerous axles from service which otherwise might have been used and have caused a serious accident. With a system properly organized, supervised and carried out, there is little danger now for a bad axle getting out into service. The use of the recording gauges and the keeping of other records is bound to reduce failures. The wheel shop foreman and his employees realize that they carry the responsibility for the satisfactory performance of each pair of wheels produced while it is in service. On our railroad, wheel-shop work is concentrated at one major point thereby making it possible to give better general supervision to the work and eliminate divided responsibility.

No wheel shop, regardless of its efforts to carry out the practices outlined in the A.A.R. Manual, can function without proper machinery. A shop faced with the obsolescence of machines and machines that are not properly maintained cannot do good work. With the need of better wheel work it has been necessary to give full consideration to the scrapping of obsolete machinery or worn-out machinery, and install modern, up-to-date machinery that will do the work required. This we have done in our shop. Deferred maintenance on wheel-shop machinery will be reflected in the hot-box record in a manner similar to which laxity in accident prevention work will reflect in your accident record.

Good wheel-shop practice does not end at the wheel shop. Regardless of how much care is taken to produce good work in the wheel shop it can be quickly destroyed by improper handling of the wheels after they leave the wheel shop. Damage to journals during loading processes must be given very close attention to avoid nicked journals. Several years ago, we developed a wheel car having saddles to accommodate the wheels in such a manner that they could not possibly shift, thereby eliminating flange and journal contact enroute. This type of wheel car has proved very successful. They will accommodate either a single-, double- or triple-deck wheel load, or from 18 to 38 pairs of wheels on the one car. The use of individual blocking for each pair of wheels is eliminated with this type of car thereby saving a large amount of labor and material. Its use also practically eliminates the need for renewal of car floors that soon wear out with the use of spiked blocks. It is likewise important to see that old wheels being shipped in are properly handled when loaded at the outside points to prevent unnecessary damage to the journals and eliminate unnecessary wheel-shop work.

With more rigid rules and restrictions placed on wheel-shop practices, it is only natural for supervision to assume the attitude that work output will decrease. Therefore, devices for checking the boring mills, axle lathes and other equipment have to be provided, master gauges furnished and considerable research done on the part of the foreman and the employees to establish methods whereby accurate work can be accomplished as quickly as inaccurate work. We have found it takes a lot of time spent in the education of employees, encouragement and

A straightening stall for damaged open-top cars

Concrete runways along repair tracks at Oneonta allow best use of material-handling equipment

perseverance, to get them to think the new way is better than the old and to develop methods to accomplish it.

The hot-box situation is more or less tied in with good shop practice. Rule 66, in itself, is a shop practice. The current A.A.R. monthly reports indicate that on practically every railroad the number of hot boxes is constantly increasing. We are research people in this respect, ever trying to lay our finger on the causes. The quality of car oils is, in our opinion, something that requires more direct consideration both from a new oil standpoint as well as proper reclamation. Better car oil is needed. Reclamation facilities require constant attention so that a standard is maintained that will meet the A.A.R. specification. Oil and waste reclamation processes are pretty well established; however, we will have to be on the alert to recognize improved facilities as the oil improves in quality so that the proper relation can be maintained between new and reclaimed oil.

Facilities for the proper maintenance of various types of brake-beam supports will have to receive some consideration in the near future. There are a large number of various kinds of brake-beam supports involving angles, springs, brackets, pins, bolts, rivets, etc. I believe the number of brake-beam supports that are found missing on cars in service indicate the need of better facilities in our shops and on our repair tracks to maintain them.

For a number of years we have had a modern brake-beam reclamation plant at the Oneonta, N. Y., shop. The plant is equipped with machinery of the type that makes it possible for one man to do all the reclamation work with a normal production of approximately 5,000 brake beams per year. Test machines are used so we are sure of obtaining a brake beam that is equally as good as and meets the test required of new beams.

The application of AB brakes to all cars by January 1, 1949, is a problem in itself. The manner of application, piping and anchorage to the car, must be proper to avoid expensive maintenance of the brakes after they are applied. Proper pipe bends, good threads and alignment of pipes must be made on the first application to prevent future failures. This application is truly a mechanical job and needs close supervision. Special pipe benders and threading machines can be provided to insure good workmanship.

The centralization at Oneonta shops of all wheel-shop work, brake-beam reclamation, journal-box packing reclamation, air-brake valve repairs, wood mill work, heavy freight car repairs, dismantling programs, material reclamation, blacksmith-shop work, jack and pneumatic-tool repairs, baggage-truck, freight-house-truck and material-handling-equipment maintenance has made it possible to develop and supervise these operations with a minimum expenditure for tools and manpower.

Our present supervisors with all their background of experience may find themselves unable to keep up-to-date. Some of the older men who have been through the mill will have to provide the impetus to the younger men, and the younger men with qualifications for study, observation and job interest, together with their opportunity for better education, are the men we must develop and depend upon for the future. The development of thoughtful interest in their jobs among supervisors and workmen has definitely become a "shop facility."

On our railroad, the Car Department Supervisors' Association plays an active part in developing ideas and provides a medium through which supervisors have an opportunity to discuss the A.A.R. rules, working agreements and their general problems. Meetings are held on each division once a month with the divisional car foreman acting as chairman. Through this medium it is possible to promote education and round-the-table discussions. The outside-point foremen and the shop foremen are afforded the opportunity to become better acquainted with each others' problems. The superintendent of car equipment, and members of his staff attend these meetings. The subject of car design is discussed and ideas exchanged on new developments and methods.

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The Chicago & North Western's "400" leaving Chicago for the Twin Cities

Colloidal Fuel*

By D. W. Machin†

Early development reviewed—Recent mid-western experiments and trials — Economics of fuel in Kansas City area

IN 1938 a casual interest in the general subject of colloidal fuel accounted for the establishment of a modest research program to be carried on at the Kansas State College at Manhattan, Kan., in co-operation with the Kansas Industrial Research Commission. As the general fuel situation became more critical in the latter part of 1942, this research work was intensified. An exhaustive study of the available literature was reviewed, the patent situation studied, laboratory experimentation was intensified, burning tests were conducted, a pilot plant for the production of colloidal fuel was constructed and operated and definite, encouraging results were obtained.

During the spring of 1943, large-scale intermittent and continuous burning tests were conducted which definitely proved that colloidal fuel (approximately 40 per cent coal and 60 per cent oil by weight) can be prepared from southwestern coal and mid-continent oil. This fuel can be satisfactorily burned in standard commercial or industrial burning equipment without appreciable alteration in a completely satisfactory manner and with an efficiency somewhat higher than oil and lower than coal. Upon completion of the research and development work and large-scale burning tests, the economics of the problem were carefully studied, a plant designed and laid out and estimates prepared. This study indicated that in the Kansas City consuming area colloidal fuel is not as economical as coal or oil when the fuels are compared on the basis of cost per million B.t.u.

This particular situation prevails in the Kansas City area because in that market both coal and oil are cheap commodities. The cost of processing colloidal fuel must be added to the cost of the ingredients, thereby increasing the final cost when measured in terms of heat units. This same condition, however, might not hold true in a consuming area further removed from the source of oil and coal and it is estimated that there are large consuming areas in the United States where colloidal fuel would be cheaper than oil. This is particularly true at points far removed from the producing-oil districts where the cost of transportation must be added to the cost of fuel oil. This study also indicated that if a critical oil shortage exists, even in the Kansas City area, and burning oil is not readily available, then colloidal fuel may replace oil and 40 per cent of the deficiency in available fuel oil would be made up with the coal contained in the mixture. This would permit the substitution of colloidal fuel for burning oil with a minimum capital expenditure or inconvenience to the ultimate consumer because no appreciable capital investment would be necessary to convert from oil to colloidal fuel. The general use of colloidal fuel in place of fuel oil would conserve a large quantity of this currently critical commodity.

Application of colloidal fuel to locomotive fireboxes was studied in a cursory way and there seems much promise for its future use in this manner. The problem of paramount importance in this use is handling of fly ash. However, with proper design, this may be alleviated. Sparking would be practically eliminated, which would seem to make the fuel suitable for forested and mountainous areas.

* Contributed by the Railway Fuel and Traveling Engineers' Association Committee on Coal for the Association's 1945 year book.

† Combustion engineer, Pittsburg & Midway Coal Mining Company.

First Patents in 1879

Colloidal fuel is not new. The earliest patents date back to 1879. This problem has been studied by capable men. In 1918 Bates made an important contribution when he made the first attempt to produce colloidal fuel commercially. During World War I the Submarine Defense Association investigated the possibility of utilizing this mixture of coal and oil. However, since the last war, due to the abundance of cheap coal, oil and natural gas, the interest in colloidal fuel diminished and it has not been until the last two years that this subject has again become important.

In 1938 the Engineering Experiment Station of the Kansas State College undertook new research work on this problem. Dr. J. H. Hedrick was placed in charge of the work and his first research was directed toward the utilization of various stabilizers. Four general types were studied: (1) dilute gels and gel formers; (2) emulsifiers; (3) petizers or solvents; (4) surface active agents. Under Dr. Hedrick, Stutzman determined the effect on viscosity and specific gravity of various coal and oil mixtures. Gradishar developed information on critical concentrations and flow of colloidal fuel through pipes. Later, Zabel continued the work started by Dr. Hedrick, giving emphasis to the study of stabilizers. And later, Landis studied methods of mixing colloidal fuel.

Early in 1943, as an amplification of the research work done by the Kansas State College, the development of a practical commercial means of producing colloidal fuel economically was attempted. This task was intensified by the growing fuel shortage in the Middle West. It appeared timely that the theoretical work should be put to a practical test. The author reviewed the work that had been accomplished to date. George Auer, attorney, reviewed in detail the patent situation surrounding this subject, prepared a complete bibliography, and read and analyzed all the available literature germane to the subject. Other technical men undertook the task of designing equipment and facilities to produce practically a satisfactory colloidal fuel.

This review of available information revealed sufficient incentive to explore further the practical applications of this general knowledge and pursue this problem through the pilot-plant stage. The laboratory investigation was then intensified. The coal puverizing facilities of the Western Minerals, Inc., plant near Baxter Springs were utilized to pulverize carloads of coal to various sizes. A pilot plant was set up in connection with the central cleaning plant of the Pittsburg & Midway Coal Mining Company at West Mineral, Kan.

Colloidal Fuel Tried in Kansas City

After pilot-plant operation, carload samples of colloidal fuel were prepared and shipped in cars to Kansas City, Mo., where the fuel could be tested in modern boilers on a large scale. The tests were conducted in the Kansas City power plant of Montgomery Ward & Company by combustion engineers of the Pittsburg & Midway Coal Mining Company with the full co-operation of the combustion engineers of Montgomery Ward & Company and were observed by a representative of the Bureau of Mines. All physical and mechanical data were carefully observed and a complete boiler and fuel test was made in conformity with the code of the American Society of Mechanical Engineers, the results of which were recorded by the Kansas City Testing Laboratory. All results from the burning tests were eminently satisfactory. No particular trouble in any phase of the burning test developed which was difficult to overcome. The general result of this accelerated investigation up to and including the large-scale burning test may be summarized as follows:

1—A satisfactory colloidal fuel for commercial and industrial boilers and processing furnaces was produced with southwestern coal and mid-continent oils.

2—The colloidal fuel tested retained the same general temperature-viscosity relationship as that of the heavier grades of Bunker C residual oil. It was observed that less total heat and lower burning temperatures were required for atomization.

3—The use of an effective but inexpensive dispersing agent, when utilizing light residual oil, resulted in a more satisfactory and stable colloidal fuel and eliminated the necessity for extremely fine and costly grinding of coal.

4—The large-scale burning test of colloidal fuel demonstrated that it is possible to maintain higher continuous ratings with colloidal fuel than it is with oil alone. The flame is more satisfactory, is softer, more completely fills the furnace, and the cutting, impinging effect obtained with certain types of oils is not prevalent.

5—It was feasible and practical to handle colloidal fuel with ordinary heavy oil-burning equipment from the tank car through lines of ordinary size and in standard horizontal, reciprocating, centrifugal, and gear pumps. Colloidal fuel performed very satisfactory through tubular heaters, and in both outside mixing, steam and mechanical rotary burners.

6—Our experimental work indicates that additional research and development is necessary both on colloidal fuel and small burners before a fool-proof application of colloidal fuel can be made to the small domestic burner. The principal problem at this point is to develop a satisfactory and economical stabilizer that will assure the practical use of colloidal fuel made from light straw-colored or gas oils in the small domestic burner and at the same time not foul the burner orifice, the filter or the valves.

7—It was determined that, under present market conditions in the Kansas City, Mo., consuming area, the production of colloidal fuel would not attract private capital. This is true because of the low cost of coal and oil in the same territory at this time. It is obvious, however, that a well-designed and economically operated colloidal fuel plant in the Kansas City area could produce colloidal fuel for heavy and light industry where a price of $1.57 per barrel of colloidal fuel is permissible. This is predicated on the delivered price of oil at $1.07 per barrel and the delivered price of $3.64 per ton of bituminous coal.

8—The design and estimate for the colloidal fuel plant indicated that a minimum quantity of critical material would be required. Complete plans and specifications have been prepared. The estimate indicates that a plant to produce approximately 800,000 barrels of colloidal fuel annually would cost in the neighborhood of $614,000.

Analysis of 3,242 Patents

The analysis of the patent situation by George Auer, attorney, developed that since the inception of colloidal fuel there have been some 3,242 patents issued on various phases of the work. A cursory examination of these patents indicated that some 119 were worth careful study and analysis. Mr. Auer's investigation revealed the following general facts:

1—Stabilizing the mixed fuel received most attention. The greatest emphasis was placed on this problem and there is a sharp criticism of opinion existing as to whether fine grinding or the use of a suitable stabilizer is the best solution of this problem.

2—Little or no attention has been given to the development of new processes or arrangements for utilizing known equipment to best produce colloidal fuel.

3—A study of the foreign patents indicated that colloidal fuel has been used in a substantial way by the European nations.

4—There is no well-defined pattern for the study of colloidal fuel as revealed by the patents and there has been a general, disorganized search for a satisfactory solution.

Mid-West Economics

A more detailed study of the economics of the problem revealed some interesting facts. As we have previously mentioned, based on the present prices of oil and coal in the Kansas City consuming area, colloidal fuel can be prepared and sold for $1.57 per barrel. This is some 45 per cent more than the present cost of fuel oil and it is evident that so long as fuel oil is available at the existing price there would be little market for colloidal fuel. Our study indicates that if a price of residual fuel oil increased to approximately $2.75 per barrel, then colloidal fuel made from that oil would be competitive in price. The study also indicates that the utilization of coal, as such, under present market prices in Kansas City would be 67 per cent less expensive than colloidal fuel. Therefore, few consumers would continue to use oil or colloidal fuel if equipment for conversion to coal is available. It is obvious that from an economic standpoint colloidal fuel cannot be profitably produced in normal times in the Kansas City area. There, colloidal fuel would be useful only as an emergency wartime measure to conserve fuel oil. As pointed out above, however, this situation might not pertain in other consuming areas further removed from the source of fuel oil.

A detailed plant layout and estimate was made for a completed plant. This estimate was checked and indicated that a plant to make colloidal fuel would be relatively simple if carefully designed devices for proper mixing, storing and handling of colloidal fuel, such as those developed, were utilized.

It is particularly significant to point out that, due to the higher specific gravity of colloidal fuel, it will not float on sea water. This means that if colloidal fuel were used in place of oil for power-generating purposes on inland or ocean-going vessels, it would minimize the loss of life due to burns, particularly during a time of war.

EDITORIALS

Railroad Men Challenged

In a challenging address, presented before about 1,300 railroad and railway supply men at the October 15 meeting of the Western Railway Club in Chicago, Wayne A. Johnston, president of the Illinois Central, discussed the following text which is both appropriate and powerful and will need constant reemphasis in the months to come: "We must have railroads in and for America—solvent railroads, strong railroads, manned by alert and respected workmen, directed by progressive management, modernized to fit the needs of post-war America, operating under sound policies of government and commanding the confidence of the American people." It is obvious that this program, backed up by deeds, will give a tremendous boost to railway prestige and public favor and incidentally do as much or more than any other one thing to restore a normal high level of industrial activity.

In his definition of "solvency," Mr. Johnston contemplates that railroads will take in more than they spend; that they will have rates attractive to traffic yet fully remunerative; that they will pay good wages for good work; that they will buy and maintain a plant responsive to every call upon it yet be able to lay aside an ample return on investment, and be attractive enough to keep private capital interested in providing a continued supply of efficient tools. In other words, railroads will be enabled to stand on their own feet without governmental assistance of any kind, except constructive regulation, and serve as a stimulating example of accomplishment by private enterprise.

By "strong" railroads, Mr. Johnston refers not merely to those well equipped with track, power, cars and other physical facilities but to the necessity for railroads strong in character, ideals and enterprise which have in the past made railroads pre-eminent in the field of land transportation. He has a definite message for railway workers, including those in the mechanical department, in the following quotation: "These railroads must be manned by alert and respected workmen—people who are proud of being railroaders, who know that theirs is a public service fundamental to national well-being, essential, reward-worthy, truly a life worth living. These alert workmen must be so interested in the progress of the industry that they will speak up for it at every opportunity and share with management and public alike the thoughts, ideas and observations they develop with respect to better railroading. They must be a team—a thorough, co-operative, hard-hitting team—one well deserving of victory in the hardest competitive game for which American business can provide the opportunity and the reward."

For management, including supervisors, Mr. Johnston appeals for a progressive viewpoint from men who have come up through the ranks experienced in rebuffs, toughening and the hard knocks acquired only in rough-and-ready railroading. He says that this management must have vision, courage, enterprise and willingness to gamble, if need be, with everything except the safety of its men, customers and customers goods. It must also be willing to assume and bear responsibility, yet delegate it to capable subordinates and thus build a team and give it strength, spirit and genuine leadership.

To effectuate some of these highly desirable results, Mr. Johnston emphasizes the need for further improvements in operating methods, roadway and mechanical equipment, personnel training programs and employee suggestion systems, traffic building and solicitation and a great expansion in institutional and public advertising by railroads. The pre-eminence of "mind over matter" is implied throughout Mr. Johnston's remarks, as he reiterates his plea against "case-hardened habits of thinking" and says that railroad men must keep open, alert and inquiring minds, always ready to admit mistakes, but constantly willing to try new ideas and experiments and always press forward, even if going forward involves some risk and uncertainty and inability to see clearly the path that lies immediately ahead. It seems obvious that this mental attitude is more important now than ever before and essential to maximum results in railroading of the future.

Lowering Boiler Costs

In the all-welded boiler, in water treatment and blow-off systems, in construction details such as the application of flues and tubes and staybolts, and in the handling of the boiler in train service lie possibilities for both the reduction in boiler maintenance expenditures and better boiler performance. The Master Boiler Makers' Association, with a membership primarily concerned as craftsmen with fabrication and maintenance problems, presented available cost figures in some of the reports prepared for the Association's 1945 annual proceedings. This is the best way of getting action from railroad offi-

cers with a reputation for wanting to know how much can be saved by either new equipment or new methods.

Experience with the all-welded boiler has been limited because of test requirements and war conditions, but the elimination of boiler leaks, the savings in weight, and the absence of any shell repairs to the Delaware & Hudson's boiler, and the renewal of the firebox throat and flue sheets to this boiler in 1943 at 304,000 miles as compared to an average of 193,000 miles for 17 other locomotives of the same class, indicate large potential savings in maintenance expenditures. Approval has been given to the construction of all-welded boilers for two other railroads, in addition to another for the D. & H., and cost data should become available as this type of boiler becomes accepted as standard. That it will be is evidenced by the confidence of the association's committee that the construction of such boilers can and should be made a standard fabrication procedure.

In the report on water treatment, the statement is made that not less than $30,000,000 is saved annually by water treatment. This figure and the estimate that water treatment is in use at less than half of the water stations where treatment could be made with economy to the railroads should be reasons enough for surveying the possibilities of additional savings in this field. In seal welding of staybolts to eliminate leakage, in cleaning tubes and flues by washing instead of by blowing, and in methods used in applying tubes and flues the association committees have either shown savings figures or reductions in the maintenance work that can be translated into dollars saved.

By lowering the steam locomotive's maintenance costs, a large proportion of which is attributable to keeping the boiler in condition for maximum performance, the position of the steam locomotive with respect to competing types of power will be improved. In doing so corresponding improvements in operating characteristics and availability will result from the increase in boiler efficiency and the reduction in shop and enginehouse time required for boiler attention.

Train Radio No Longer Experimental

One of the last restraints to general application of train communication was removed by the Federal Communications Commission on November 14 when it released proposed rules and regulations for governing railroad radio service. The railroads were given a twenty-day period in which to present reasons why the rules should be changed and unless otherwise ordered by the Commission, the rules and regulations will go into effect on December 31, 1945. Few objections are anticipated and it seems improbable there will be any delay.

To avoid misunderstanding, the Commission's proposed rules begin with definitions of "railroad," "railroad radio service," "train radio station," "yard and terminal radio station" and "railroad utility radio station." Concerning licenses, it states that the licenses period shall be for two years, all licenses expiring at 3:00 a. m. eastern standard time on February 1. Those eligible for licenses are "persons or organizations operating as railroad common carriers." The rules add, however, that "experimental authorizations may be issued to communications common carriers for the purpose of providing railroad radio service." Some railroad operators would like to have this clause changed, since they see in it the possibility of an encroachment which might result in the railroads becoming the lessees of a service rather than having complete control of their own train communication service.

Construction permits are not required for radio stations on railroad rolling stock and provision is made for direct application for license for such equipment. Apparently identical sets may be interchanged between stations without the need of a new license.

A section of the rules on technical specifications lists specific channels, states that modulation shall not exceed 100 per cent on peaks, that with frequency modulation, the deviation of the carrier from the assigned frequency due to instability shall not exceed 30 kc. and that carrier frequency shall be maintained within 0.005 per cent of the assigned frequency. Provision is made for a railroad to make application for authority to use special emission for the operation of signaling, calling and similar devices. This opens the way for consideration of the use of radio in connection with C.T.C. and similar systems.

Under the heading, "Scope of Service," the rules afford the widest possible use of radio communication, allowing intercommunication by the railroads with other licensed radio stations in emergencies and the use of a single station by a group of railroads where this practice is desired.

A section of the rules on records lists those which a railroad radio station lessee must maintain. They are simple and the railroads should be able to maintain them without difficulty. The various tests which railroad radio service licensees are required to make are listed under a section on tests.

Miscellaneous railroad requirements, gathered into a final section, permit a railroad to use various methods in identification of stations, permit railroad employees to operate radio stations without radio operator licenses under conditions set forth in the order, and list inspection requirements. None of these will apparently involve any difficulty.

There still remains with the railroads the problem of obtaining equipment, of determining where communication may be employed to most advantage, in what type of service it should be used first and to what extent it should be applied. The latter requirement will be largely a matter of evolution, but if given some thought now, future alterations will be simplified. The question of power supply, although involving types of equipment which are old in the service of railroads, is lagging be-

hind the development of the very new communication apparatus.

One thing pertaining to radio equipment which should receive prompt attention is the matter of continuous communication in cuts and tunnels. It is felt by some that frequencies in the neighborhood of 2,600 megacycles should be used, since in this range the narrow spaces between cars and side walls serve as wave guides and to a certain extent at least surmount this difficulty. The Commission has expressed its willingness to listen to railroad requests for channels in this yet unallocated section of the spectrum in case it offers special advantages.

Unfortunately, the equipment required for these higher frequencies costs from two to three times as much as that for the 160 mc. range and such added cost would be an effective deterrent to the use of radio for train communication. Experiments now in progress indicate that inexpensive means can be developed for effecting continuous communication with the already assigned frequencies.

In addition to offering proposed rules and regulations for radio train communication, the Commission on November 15 announced that it was considering the possibilities of relaxing the present low power rules governing railroad carrier-current train communication systems. These rules, which were issued originally to limit interference caused by remote controlled tuning of broadcast receivers, has caused the railroads some difficulty which a slight easing of the rules would remove and it is apparent from the Commission's statement that it will do all that circumstances permit to promote the use of carrier type train communication. Given some relaxation of the low power rules, carrier can give radio more effective competition. This should serve as stimulation to those who are promoting radio and help to effect rapid application of train communication. The Commission has been considerate, generous and intelligent in making its allocations, and it is important that the railroads make applications to justify and to hold the position they have been given in the communication field. Railroad operating improvements already effected would appear to offer sound economic advantages to considerable use of train communication.

A.A.R. Research On Counterbalancing

Probably in no single instance is the criticism of American railroads for lack of modern research more fully refuted than in the case of counterbalance studies and tests conducted by the Association of American Railroads with a view to improving the operation of reciprocating steam locomotives, especially in high-speed service. With ever-increasing emphasis on high-speed operation in recent years, even with heavy trains, boiler capacity was increased to make possible substantially higher speeds and it became apparent several years ago that greater refinement in methods of counterbalancing locomotives would be required for satisfactory steam locomotive operation.

To meet this need and make a thorough technical study of the problem, a special committee was appointed by the A.A.R. and instructed to prepare a program of road tests under actual operating conditions, check the correctness of current methods and theory and finally develop a recommended practice as regards counterbalancing locomotives which would produce the desired results in modern high-speed operation. This special committee included representatives of both the Mechanical and the Engineering Divisions of the A.A.R. to assure the necessary co-ordination in interests of both track and equipment.

An extensive series of tests was conducted in the fall of 1941 and the summer of 1942 at Harvard, Ill., designed to show the effect on track and equipment of several different counterbalancing methods. Revolving parts were balanced on both the dynamic and static basis, with reciprocating compensation varying from 56 per cent to 0, equivalent to a reciprocating unbalance of 2.3 to 6.4 lb. per side per 1,000 lb. of locomotive weight in working order.

Three types of locomotives were tested, namely, 4-6-2, 4-6-4 and 4-8-2, and 495 test runs were made with speeds at 5 m.p.h., at diameter speed and at speeds as near 100 m.p.h. as could be obtained. A comprehensive report covering these tests and results, published by the A.A.R. in March, 1944, included a total of 319 9-in. by 12-in. pages replete with illustrations of special test equipment, charts, tables of test data and conclusions.

The very magnitude of this imposing volume precluded its maximum use by mechanical department personnel and particularly the shop forces who in the last analysis must understand and put into effect the desired improvement in counterbalancing practices. A Manual Committee, comprising representatives of the A.A.R., individual railroads and the three major steam locomotive builders, was, therefore, appointed to digest the comprehensive and voluminous 1944 A.A.R. report and reduce its findings to more condensed, usable form. The result was a concise pocket-size Manual of Counterbalance for Reciprocating Steam Locomotives, containing only 30 5-in. by 9-in. printed pages and made available to railroads generally by the A.A.R. Mechanical Division secretary's office only last month.

Preliminary reactions to the distribution of this small but authoritative discussion of one of the most important single features of steam locomotive design are highly favorable and the book promises to constitute a real contribution to improved locomotive operation. The A.A.R. is to be congratulated, not only on the thorough and competent way in which a modern research project of great importance has been carried on, but the effective means developed to make results of the research generally available and usable.

Factors Affecting

Cinder Cutting of Boilers*

Railroads report on how to reduce and eliminate cinder cutting—Association study includes slagging of flues and tubes, and washing versus air blowing in flue cleaning

THE Master Boiler Makers' Association, in a letter to the chief mechanical officers of all the major railroads, requested a report on cinder cutting from each railroad for compilation into a committee report. It asked for information on the nature and amount of cinder cutting and the measures taken in the past and future plans to reduce or eliminate this costly item of locomotive maintenance. The reply from each railroad has been assigned a number and is quoted in the order received.

1—The greatest improvement we have noted so far in experiments which we have conducted has been due to an adjustment of arch heights. We determined that no great amount of cinder cutting is experienced with an opening between the arch and crown sheet of at least 130 per cent of the flue area. When the opening above the arch is less, cinder cutting very rapidly develops to a harmful extent. We have also observed that streamline surfaces on superheater parts reduce cutting.

2—On 4-8-2 class locomotives, most of the cutting is confined to the 2½- and 3½-in. flues located in the two outer rows on the sides and the bottom two rows. On the 4-6-4 class, cutting takes place in the 2¼-in. flues between the 5½-in. flues at the center of the back flue sheet, and in the two rows of 2¼-in. flues below the superheater flues. Crown bolt heads are cinder cut at the 14th row from the back flue sheet diminishing at the 5th row. Staybolt heads in center syphon, both sides, are cinder cut from the 9th row top in a half circle downwards about five rows. Considerable cinder cutting is experienced in the front end of this class. On the 2-10-2 class, cutting takes place in the 2¼-in. zone of flues between the syphon, two rows from the 5½-in. flues down. Very little cinder cutting is experienced in the front end.

Regardless of their condition, after stipulated mileage and at classified repairs, all open flues which are subject to excessive cinder cutting are removed and renewed using number 10 gage safe ends. Baffle brick applied to syphon-equipped Santa Fe Class locomotives has reduced cinder cutting as well as plastering.

3—Until about three years ago we had very little trouble from cinder cutting. However, after the application of stokers, which made it possible to supply the increased steam rate required to handle greater train loadings, cinder cutting became a serious problem. The cinder cutting in the neck at the front end of the Type A superheater units was the most serious and this has been practically overcome by the use of shields. Considerable effort was concentrated on the re-drafting of our locomotives and we have secured to some extent a better gas distribution through the tubes and flues. As a result the reduced velocity of the gases has also reduced the cinder cutting. This problem has not been eliminated and we are continuing to study the gas distribution because we feel that cinder cutting is a function of gas velocity.

4—In the past some cinder cutting of superheater unit bends immediately below ball joints at the superheater header was eliminated by installation of deflector plates and shields. Minor cinder cutting is experienced on the lower portion of the smokebox front end door on our large freight locomotives. There is also some evidence of cinder cutting on radial stay heads in the crown sheet between firebox syphons. We do not know of any remedial action for this condition. It is to be expected that some cutting must necessarily take place at that point because the gases, together with abrasive material, are carried over the brick arch in many instances at rather high velocity.

5—Prior to 1932 we had very little trouble from cinder cutting except on locomotives operating in lignite burning territory. After more intensive utilization of steam locomotives was inaugurated and appurtenances were introduced to obtain higher capacities, damage from cinder cutting began and its seriousness has increased with the progress made in obtaining full use of the locomotives.

We have not resorted to any of the numerous short cuts proposed to minimize this trouble, such as a change of brick arch, welding protecting beads on staybolt and crown stay heads, heavier ends on flues and front end changes, but have confined our efforts to making repairs to affected parts before such time as experience has shown that failure may occur.

It is our opinion that cinder cutting is the result of the high firing rates required to get maximum capacity of locomotives and is influenced adversely by the type of coal used necessarily for stoker-fired locomotives. It is very questionable in our minds if there is any net saving in changing appurtenances as experience has shown their fuel saving values and we are convinced that the damage

* Abstract of a report prepared for the 1945 year book of the Master Boiler Makers' Association.

from cinder cutting does not justify increasing the fuel bill or reducing the locomotive's capacity. We think the best method of control is to make repairs to cinder cut parts at such periods as experience has demonstrated failures may occur.

6—Very little cinder cutting of flues and firebox sheets is experienced on our locomotive boilers. There is slight cutting of crown bolts and staybolt heads in the two top rows on right and left sides of Thermic syphons. This has been reduced by arc welding a bead at rear of the bolt with the boiler full of water. We have followed this practice for several years with no damage to the sheets.

On 2-8-4 freight locomotives some cutting occurred after approximately 130,000 miles of service. The abrasive action takes place inside the tubes at the prosser mark on the outside rows of tubes. This trouble has been practically eliminated by leaving the two outside rows of tubes unprossered. Cinder cutting in the smokebox, especially on the front door and smokebox ring was eliminated by the installation of a baffle.

7—Atlantic region: No cinder cutting in firebox, with the exception of a few staybolt heads in the upper portion of syphons. Very little trouble with tubes and flues. Most of the cinder cutting occurs on the front bends of superheater units in the smokebox and on smokebox front door and ring rivets. These are being protected by suitable shields or baffles. Central region: Some cinder cutting on staybolt heads on the inner side of syphons at the top front area, necessitating staybolt renewal about every four years. The front end bends of superheater units in smokebox and the smokebox front door and ring rivets are subject to cinder cutting, but are now protected by suitable shields and baffles. Western region: Staybolt heads in the upper portion of syphons subject to the same cinder cutting as experienced on the Atlantic and Central regions, also some cinder cutting of crown bolt button heads in the front area of the crown sheet ahead of the brick arch. Superheater flues show a tendency to cut close to the return bend of the superheater unit, and the effect on the superheater unit front bends in the smoke box is similar to that found on other regions. Eastern lines: Very little trouble from cinder cutting. Western lines: Experiencing some trouble with cinder cutting of staybolts and crown bolts and with side tubes on locomotives equipped with the Type E superheater.

In our opinion the most essential condition to prevent cinder cutting is the correct drafting of the locomotive to obtain the lowest gas velocity consistent with free steaming. On some locomotives the condition was greatly improved by the adoption of the A.A.R. Master Mechanic's front end and the correct proportioning of gas areas in accordance with the A.A.R. recommendation. In the front end, superheater unit shields are used to protect the units, and baffles to protect rivet heads, etc., but any attempt to use baffles in the firebox itself has merely resulted in the cinder cutting being transferred from one location to another.

8—There has been some cinder cutting of staybolt heads on crown sheets and the fire end of the small flues of our 4-8-2 and 4-8-4 locomotives. We have tried several methods of overcoming this trouble, but have nothing conclusive to report at present.

9—We were having a number of flue failures caused by cinder cutting, mostly in passenger power, which we attributed to a lack of spacer brick between the flue sheet and brick arch and after going back to the spacer brick and applying seven rows of brick to the arch very little trouble has been experienced.

10—Our 2-10-4 coal burning locomotives built in 1937 gave us some concern when new by starting to cut the heads of crown sheet staybolts. We applied electric beads back of the bolt heads in the affected zone on a few locomotives, but later we lowered the brick arch and the cinder cutting stopped. We have no cutting in the firebox or on flues. Superheater units are protected by shields and shields are also applied to the feed water heater piping in the front ends of the 2-10-4 coal burners.

11—Cinder cutting in our boilers has never been a major problem, mostly due to the grade of coal used and the drafting arrangement. Our renewals because of cinder cutting is very slight as protection of affected parts has been very successful. Fireboxes, when applied, have a bead of weld placed in front of the bolts and radials in the known areas affected by cinder cutting and additional welds are made, if necessary, while the locomotive is in service. We have eliminated the prossering of the 2¼-in. flues of all combustion-chamber type locomotives in the areas most affected, which has resulted in longer flue life and reduced cutting to a minimum. Cinder cutting in front ends of locomotives has always been more pronounced and requires considerable maintenance. Baffle plates and shields are used to protect the various parts affected, mainly the superheater units, smokebox front and steam pipes. Netting, when necessary, is either patched or renewed.

12—We were not experiencing this trouble a few years ago but cinder cutting is now a serious problem in our stoker-fired locomotives which, in my opinion, has been brought about by various changes having been made in the locomotives. Changes consisted of application of stoker, increasing the exhaust cavities in nozzle base, larger exhaust tip, larger stack and extended lift pipe, sealed arch, and increased steam pressure. These changes resulted in a much more efficient locomotive, as we were able after such changes to efficiently handle heavier passenger trains and increased tonnage on freight trains at increased speed. The increased consumption of fuel results in a large amount of partially burned particles of fuel and cinders to pass over the arch at very high velocity which results in a sand-blast effect on the various parts.

Recently we eliminated the sealed arch on two of our heavy Pacific-type locomotives for test purposes, applying four-inch spacer bricks, and practically eliminated the cinder cutting in the firebox zone, the burning and fire cracking of the flue beads, the excessive burning of the back ends of superheater units, and the accumulation of slag on back tube sheet. We obtained the same results on Mikado-type locomotives on test and we have now adopted the open arch on all stoker-fired locomotives.

13—On 2-8-8-2 type locomotives the flues in the top central portion cut through on the bottom just inside the back flue sheet at the shoulder formed by prossering at approximately 50,000 miles. Discontinuing the prossering increased the mileage to approximately 150,000 miles. The top central portion of the back flue sheet and the crown bolts over the top of the arch have to be renewed at approximately 300,000 miles. While no means have been found to eliminate renewals, they have been reduced by maintaining a full brick arch. The sides of the smokebox have to be patched at approximately 200,000 miles.

On the 2-6-6-4 type locomotives the back flue sheet has to be patched at the top or renewed and some of the crown bolts have to be renewed at approximately 450,000 miles. Some superheater flues have to be renewed at approximately 450,000 miles due to cutting by the deflection of cinders at the supports for the superheater units.

14—We have had serious cinder cutting of flues, front end appliances, superheater coils, and smokeboxes which we have endeavored to overcome by manipulation of the

brick arch. The changes cause the locomotive to steam poorly and if it does steam properly, we experience cutting on crown staybolt heads and crown sheets. In some cases we have been able to overcome cinder cutting by enlarging the nozzle opening to the largest extent consistent with good steaming. On nozzle tips equipped with a four prong bridge, flues are cut faster than with a ⅜-in. or ½-in. round or diamond bridge installed parallel with the cylinder. We are increasing the size of nozzle tips where possible and installing round or diamond bridges. It is believed that a good deal of our trouble is caused by our coal which has a very high and hard ash content.

15—We shield parts when cutting takes place, but this does not stop the cutting and it is a continuous job to renew shields. The open tubes and flues located at the sides and bottom of the flue sheet are cut most with very little cutting of the flues and tubes located in the center. It is our practice to run flues and tubes until cinder cutting is noted. Then thimbles are applied. Flues and tubes that have had thimbles applied sometimes cap and slag over and cinder cutting then develops in the other flues. A few locomotives have been equipped with unprossered flues and tubes which has prolonged the life somewhat. Cinder cutting of units is prevalent particularly in the top row. The Type E units cut more than the Type A.

The cinder cutting of staybolts has been reduced by increasing the distance from the arch to crown sheet. When our Class S freight power was first placed in service the brick arch contained 10 rows of brick, and cinder cutting of crown and syphon staybolts was experienced. The arch was reduced to 8 rows of brick which practically eliminated cinder cutting of staybolts. Some cutting occurs on crown bolts between syphons. Our method of protection is to weld a bead of weld part way around the head of crown bolts.

In passenger locomotives of the 2-6-2 type that are used in through line service the cinder cutting takes place in different locations on the tube sheet and flues. They are all equipped with the same nozzle, ashpans, and grates. We shop them after Class 3 repairs at 84,000 miles for a Class 5 repair, with no flues removed; the next shopping at 168,000 miles with part flue removal; the next shopping at 250,000 miles with full flue removal. At this time some of the 5½-in. superheater flues are cinder cut inside where the back unit band rests on the flue; the cutting action is at each side of the band. We apply long safe ends or renew the flues. The 2¼-in. tubes are cut at the sides and top of the flue area on the passenger power and in the center of the flue area on other power. Our only preventive is to apply shields or thimbles in the 2¼-in. tubes in the firebox end and shields in back of headers toward the front tube sheet to prevent the cutting of headers. Our boiler fronts are all shielded to prevent cutting.

16—On this railroad cinder cutting of tubes and flues occurs generally between 80,000 and 100,000 miles. Thimbles are applied on the inside of tubes and flues after they have made approximately 60,000 miles to prevent failures at a later date. Cinder cutting on tube sheets is nil. We have some cinder cutting of crown bolts, staybolts, and of syphon staybolts in the top front section of the syphon. To overcome cinder cutting of staybolt heads, half moons are electric welded within ⅜ in. of the staybolt head, thereby deflecting the cinders so they do not come in contact with the bolt heads.

Cinder cutting of both Type E and Type A superheater units is most noticeable on the vertical section of the unit in front of the small flue holes. We have installed baffles in front of small tubes on a few locomotives for test, and it appears that this arrangement may have merit, but the tests have not run long enough to draw any conclusions.

A cinder deflector applied in the smokebox to reduce cinder cutting of the boiler front has not only protected the boiler front but also caused an unexplained decrease in cinder cutting of staybolt heads as it is reported that we are finding a smaller number of half moons that require renewal on monthly inspections.

17—Our history on this topic indicated that we should first consider the locomotives that are assigned to the task of moving the tonnage over the districts at a higher rate of speed which, in this sense, has increased the rate of evaporation and likewise has affected the cinder cutting action caused by the abrasive action of the ash contents of the coal used on different districts. Therefore, when comparing, for instance, the same design of locomotives without combustion chambers on two different districts using different types of coal, we have been confronted with differences as to the locations of cinder cutting and the abrasive action on the parts involved as follows:

District No. 1—The cinder cutting was more noticeable on radial stay heads and the top 18 in. of back flue sheets. The flues within this area and the superheater units were also affected.

To prevent the excessive cinder abrasive action various tests were conducted. Removing the top row of brick from arch increased fire hazards and increased fuel consumption, but the cinder cutting was somewhat reduced; however, not with sufficient merit to warrant the loss of the increased cost of fuel.

We have lowered the back end of arch tubes to permit a greater area between the crown sheet and top back row of arch brick without changing the length of arch from back flue sheet. This has helped to reduce the abrasive action at radial stays and is considered a step in improving the design to further prevent the abrasive action at fire ends of radial stays and has not affected the fuel consumption. Some changes were made in the size of exhaust nozzles but the increases in nozzle size affected the steaming qualities and the exhaust nozzles were changed back to the original size.

Radial stay heads have a welded bead applied (in half circle design) approximately ¼ in. wide and about ½ in. back of each radial stay. When this welded bead is worn off (about once every year) the bead is again built up to standard. The bead has also helped to break up the cinders and slightly reduced the abrasive action on the fire end of flues and back flue sheet, although the cinder cutting is still prevalent on these parts.

The superheater unit shields at front end have been increased from $\frac{3}{16}$ in. to ¼ in. in thickness which has helped prolong the life of shields between replacements. The superheater header is protected by a ½-in. plate attached across the top of superheaater units and so shaped and applied as to not restrict the draft through the top flues. It is attached about 6 in. ahead of the flues and close to the header and bent at about an 80-deg. angle which deflects the cinders downward from the superheater header. These plates or shields are renewed as they become worn (about each general shopping of locomotives). The interior surface of the smokebox where the abrasive action is most severe has a ½-in. liner welded to the area involved. These plates will last from 6 to 8 years. The protective measures have not interfered with the steaming qualities of locomotives and have not interfered with the fuel performance, both of which are of prime importance, and we find them to be the most

efficient method of combating the cinder action in this district.

District No. 2—We are confronted with a slightly different condition because of the different coal used with the same class and design of locomotive. A honeycomb develops on the back flue sheet and a stoppage of flues occurs throughout the entire flue area. The latter starts mostly in the center of the flue area and thus deflects the gases at high velocity through the outer rows of flues which subjects them to cutting by the high ash content of the coal. This grade of fuel does not have the severe abrasive action on radial stay heads as encountered on District No. 1. Baffle plates applied in the front end at each side of the smokebox transferred some of the cutting action to flues in the next vertical row on each side. Consequently, we removed the baffles in some instances and have experimented with applying thimbles or bushings in flues in each outside row and renewing those found cinder cut at each monthly inspection. This method has helped and has not interfered with the steaming qualities of locomotives, and it has prolonged the life of flues between resettings of the flues involved. It has also increased the availability of locomotives to a certain degree.

We have several locomotives equipped with Circulators and due to the shape of the brick arch it has reduced the cinder cutting on flues slightly. In this district we are also confronted with superheater unit bands becoming burned and badly distorted which interferes with draft through superheaater flues and increases the draft velocity through the smaller flues after the superheater flues become plugged, particularly on the locomotives assigned to long runs. Locomotives equipped with front-delivery stokers have less carry over of cinders into the flues resulting in less cinder cutting. Results of tests indicate that the discharge of cinders from the stack are about one-third less for front-delivery stokers as compared with rear-delivery stokers.

Therefore, based on our experience we have reached the conclusion that in each class or design of locomotives the type or grade of coal and the operating conditions are at times the governing factors. No one standard method of stopping the abrasive action can be adopted and affected parts must be protected wherever it is practical to do so.

18—Cinder cutting has been one of our greatest sources of trouble in firebox maintenance, especially in the past four years. Crown stays, syphon staybolts, back end of combustion chamber syphons, smokeboxes, boiler fronts, saddle bolts, steam pipes, feedwater heater pipes in smokebox, and particularly tubes and flues have been cut.

We have tried various methods for the protection of parts being cinder cut, but nothing much has been done to prevent or eliminate the causes of cinder cutting. The use of crown sheet baffle brick helped a little, but the trouble of keeping brick in place more than offset the benefit derived from its use. Thimbles are applied to tubes on both sides of superheater flues which stopped the cutting of tubes, but increased the plugging of tubes. Heavier gage safe ends were tried, but started to crack 25 per cent sooner than the standard safe ends. The electric welding of a bead on the back side of crown stays deflected the cinders and stopped the cutting of crown stays. On cinder-cut parts of boiler fronts, steam pipes, and feedwater heater pipes, ⅛-in. and ¼-in. shields are applied to the affected parts, and run from two to three shoppings before renewing.

The most serious cinder cutting, on passenger power at 120,000 miles, was the cutting through of the tubes between and on both sides of superheater flues. The application of Tuyere grates, which has a tendency to baffle and soften the flow of air through the grate, has reduced the cinder cutting to some extent.

Previous to 1941 cinder cutting was very light, but due to increased speed and heavier tonnage of both freight and passenger trains, the firing rates were increased to obtain maximum boiler output. The higher firing rates produced high gas velocity and more cinder cutting because of poor combustion. In order to overcome or reduce cinder cutting, we must have good combustion.

One of the most important items in controlling cinder cutting is the proper cleaning or blowing of flues and tubes. This cannot be over-emphasized, because it has been found that locomotives of the same class that have had flues and tubes kept clean from shopping to shopping, have had far less cinder cutting than those that have had flues and tubes partially plugged.

We have tried numerous arrangements of smokebox plates and different sizes of smoke stacks and extensions. In most cases, they did not prove of much benefit.

19—We have practically no cinder cutting on the firebox sheets, crown stays, or staybolts. Cinder cutting in the interior of the smokebox around the heads of cylinder bolts is minor when considering the long life of these parts before renewals. The traces of cinder cutting in the firebox have been directly over arch brick on the crown bolts. We believe cinder cutting was due to restrictions at this point and the low diaphragm plate. With removal of these restrictions, the condition improved, and cinder cutting disappeared. The openings at these points should be equalized and be large enough to allow the lowest possible gas velocity attainable through the flues that will maintain good combustion for the locomotives.

20—When cinder cutting first began to become alarming, a check was made on one district maintaining 122 heavy freight locomotives and 74 passenger locomotives to determine the number of open flues and tubes subject to cinder cutting that it was necessary to remove at inspection periods to prevent flue failures. It was found that 3,273 flues and tubes had been renewed, the average life being approximately 45,000 miles.

A check on the same district was again made after cinder baffles had been applied to the open flues and tubes that were subject to cinder cutting, which developed that it was necessary to remove 1,396 flues and tubes in a like period, a reduction of approximately 57 per cent, the average life being approximately 65,000 miles before renewals were necessary to prevent flue failures. Also, more attention has been paid to flue cleaning and lately we have started to wash flues.

Report of E. E. Owens

As an addition to my paper on cinder cutting for last year the following data will cover our experience since that time:

Our latest 4-6-6-4 type locomotives built in the latter part of 1944 are the same as the 4-6-6-4's built in 1942 and 1943 but have Type A instead of Type E superheaters, and have a Circulator in the combustion chamber in addition to the five in the firebox to prevent cinder cutting wear on the back flue sheet and flues.

After these engines were in service for 90 days a close inspection was made for evidence of cinder cutting damage. It was noted flue beads were polished and some wear just inside prosser mark on side wall of the tubes. This cinder wear progressed rapidly and at about 35,000 miles we applied thimbles in outside rows of the 2¼-in. tubes to enable us to keep them in service until necessary to shop for machinery repairs at approximately 60,000 miles. At that time we found it necessary to change 28 superheater flues and 75 tubes at the top and the sides of

the flue sheet due to the cinder cutting. It was necessary to protect the Circulator riser tubes by welding on ⅜-in. round rods to the back side extending from the crown sheet downward 16 to 18 in. and to weld shields back of the staybolt and crown bolt heads over the arch to protect the bolts and prolong their life. We merely concentrated the cinder wear to different areas and proved no prevention had been obtained.

In contrast, the Mountain-type locomotive in passenger service which has four Circulators in the firebox and one in the combustion chamber, referred to in my 1944 report, had approximately 300,000 miles without removal of any flues due to cinder cutting. However, this locomotive was shopped for Class 4 repairs in March, 1945, and we changed a total of 110 flues and tubes. Six superheater flues and 54 tubes account of cinder wear and the balance of the 110 were changed to clean out and condition all flues and tubes to go the 4 year limit which will be in March, 1946. This engine now has 390,000 flue miles and proves that Circulators properly located in fireboxes are beneficial in prolonging life of flues and tubes against cinder cutting wear. In view of the above performance, we possibly have a combination in this firebox that can be worked out to solve some of the trouble experienced from cinder cutting on our heavier power.

Slagging of Flues and Tubes

In a report on the slagging of flues and tubes S. F. Wentz, special piecework inspector, New York Central, stated that slag is not directly chargeable to poor firing but it will start and hasten the spread of slag and clinker. He noted that methods used in firing coal from various territories are basically the same but in firing coal with a high percentage of iron, silica, lime, and suplur, the fire should not be disturbed any more than is absolutely necessary with the grates being rocked slightly and frequently.

E. E. Owens, general boiler inspector, Union Pacific, reported that slagging of flues and tubes on MacArthur and heavy Pacific type locomotives started in the fall of 1944 when Illinois coal was used because of the high war tonnage. These locomotives would arrive at terminals with the flues and tubes honeycombed over. Brick arches that previously gave 30 days of service, when burning western coal, were being replaced in 15 to 20 days and it was necessary to clean and blow the flues each trip. The air openings in the grates and front end drafting were not adapted to the fuel and the slagging was aggravated by the slightest leaks in the fireboxes and front ends. The condition was corrected by the mixing of Illinois and Wyoming coal in equal proportions.

Cleaning Flues and Tubes

By S. F. Wentz

There are two methods used in cleaning flues and tubes. The first and old method is by blowing the flues and tubes with compressed air and the second and recommended method by washing the flues and tubes with water and air. The number of flues and tubes that require cleaning is noted on the work report showing the number plugged solid and the number partly plugged. All flues and tubes that are plugged solid, all flues and tubes partly plugged above and below the units and all return bends of units that have a slag build up on the ends should be marked to be cleaned. Fig. 1 shows a tyical slagged flue sheet and plugged flues.

When an oil torch is used to candle the flues and tubes, those that are only partly plugged and the units that have a slag build up on the ends will draw the flame which results in some of the flues not being marked for cleaning. It is a better practice to use a flashlight with a good focus to examine flues to see if they are plugged in the front end or above or below the units or if there is a slag build up on the ends of the units. Units that are warped or have turned up or have missing unit bands should be replaced.

The flue cleaner should remove the loose cinders from the flues at the firebox end, the slag from the ends of the units with a hook, and any crust of unburned coal that is sometimes formed around the interior of the flues at the firebox end. A ⅜-in. flue-cleaning pipe, at least one inch longer than the flues that are being cleaned, Fig. 2, should be used with not less than an air pressure of 100 lb. per sq. in. The flue-cleaning pipe should be inserted the full length above and below the units on flues that are equipped with superheater units and the full length on the open flues and tubes as shown in Fig. 3. When a short flue-cleaning pipe is used, it only blows out the flues at the firebox end and tends to plug the front end of the flues more solid. After the flue cleaner has completed his operation the flues are again examined by the inspector to see if the flues and tubes are properly cleaned, marking any that do not pass inspection for recleaning.

The second method of cleaning flues and tubes with water and air differs from the first method as it is only

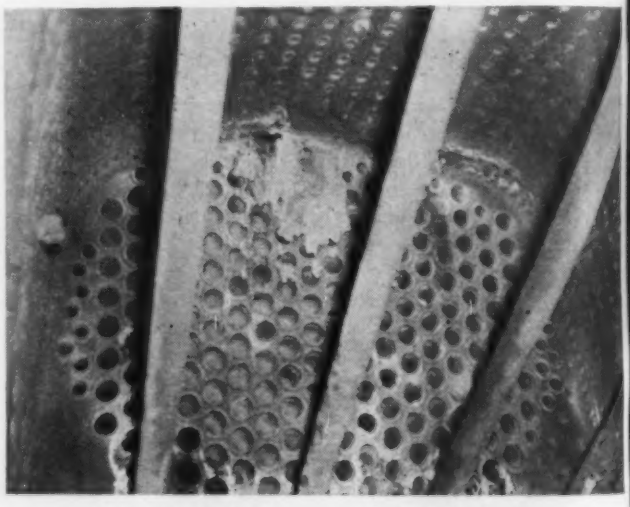


Fig. 1—Typical slagged flue sheet and plugged flues

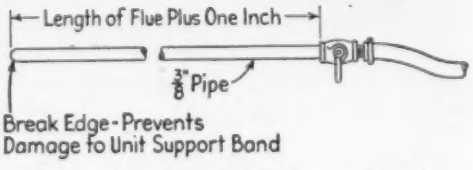


Fig. 2—Flue-cleaning pipe of correct length

necessary to hook out the loose cinders and the slag from the ends of the units so the flue washing machine, Figs. 4 and 5, can be inserted in the flues. It is necessary to blow the flues that are plugged solid to get a passage through them prior to washing. If an attempt is made to wash a flue that is not partly opened, the accumulated pressure should immediately be released by opening the bleed-off pet cock before the locking lever is released to remove the flue washer from the flue.

The washing machine is inserted in the flue and the operating lever pulled back to the locking position, Fig. 6, which tightens the machine in the flue. The water hose is connected from the washout line, which should be not

over 120 deg. F., to the washing machine and the air hose connected. An air pressure of at least 100 lb. per sq. in. should be used. The cleanout plug is removed from the bottom of the smokebox and a funnel welded to a flue is placed underneath the cleanout plug hole, the flue

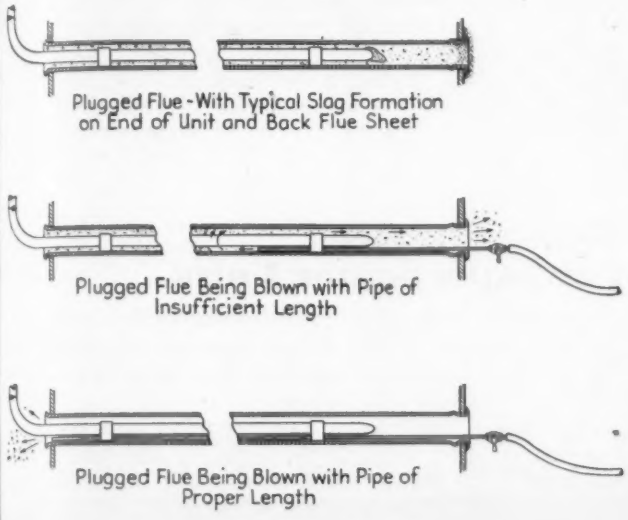

Plugged Flue - With Typical Slag Formation on End of Unit and Back Flue Sheet
Plugged Flue Being Blown with Pipe of Insufficient Length
Plugged Flue Being Blown with Pipe of Proper Length

Fig. 3—Method of using flue-cleaning pipe

Fig. 4—Flue-washing machine in full release position

extending to a box on the floor or mounted on a wagon of the desired size which is placed in front of the locomotive to catch the water and cinders and prevent the cinders from going into the drain in the pit as shown in Figs. 7 and 8.

Washing should start at the top row of flues, working across the flue sheet and then continuing with succeeding horizontal rows to keep water and dirt from leaking into flues already washed. The water cock valve is opened for several seconds; then the air is turned on for a few seconds allowing the air and water to pass through the flue and remove the accumulation contained therein. The water is then turned off and the air allowed to blow for a few seconds more to remove the water and dry the flue. The time required to keep the water and air on depends on the accumulation inside the flue and after a few flues have been washed the flue cleaner can judge the length of time required for each operation.

Passenger locomotives running on one road had to have the flues blowed about every round trip to prevent low steam failures on account of plugged flues. The railroad started to wash flues with a flue-washing machine similar to the one shown in the 1943 proceedings and after making a test, it was found that the flues required no cleaning in a 15-day period and in several instances only three flues were found plugged after being in service for a 30-day period after the flues had been washed.

There are several advantages in washing flues; it is a quicker and easier operation; the flue cleaner does not have to contend with the soot and dust, and all the soot, an excellent insulating material, is removed from the flues and units. Also, while the flues are being washed the accumulation in the front end is thoroughly removed.

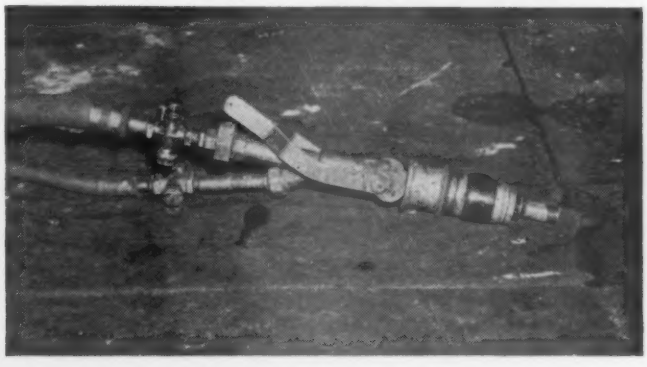


Fig. 5—The rubber bushing expands to hold the machine inside the flue

Fig. 6—Locking the flue-washing machine inside the flue

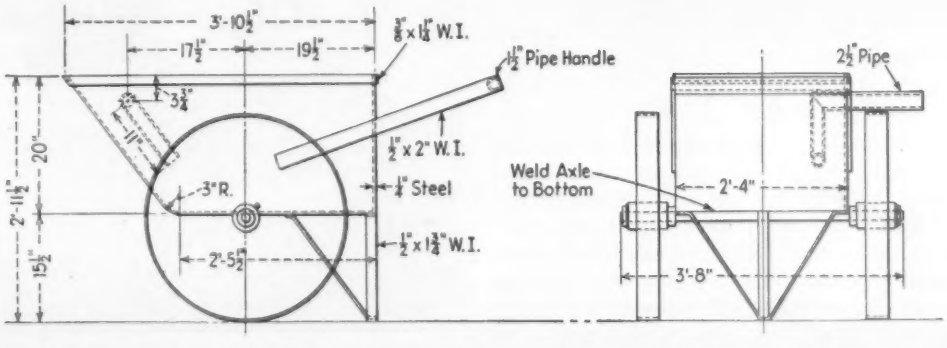


Fig. 7—A wagon designed to remove cinders from the water and to carry them out of the shop or enginehouse to the cinder dump

Another railroad washed the flues on seven locomotives in passenger service and after making one round trip the flues were examined. Five of the locomotives making 1,176 miles had a maximum of three flues plugged and none honeycombed per locomotive and the other two locomotives making 806 miles had no flues plugged and four

Fig. 8—A box separates cinders from the water draining into the pit

flues honeycombed. Eleven locomotives averaged 9,801 miles each in one month before it was necessary to again wash the flues.

From the tests made on washing flues, it appeared that much better results were obtained from washing the flues than by blowing them with compressed air.

Washing Flues

By E. E. Owens

In regard to washing and blowing of flues, we have obtained good results from washing flues and tubes at each monthly inspection period and have reduced complaints of engines not steaming as much as 80 per cent by washing each flue and tube under pressure once a month.

We use a combination washout nozzle with air line to blow out the flues and tubes. The washout nozzles have a tapered oak plug to fit the size of flue being washed to prevent the water coming out the back end as considerable pressure is obtained. A 3-in. washout plug is applied to the bottom of the smokebox to drain out the water. We also use a washout nozzle with rubber ferrules which are expanded inside the flue by a screw arrangement. We have used this nozzle over a period of months and have found no flues completely stopped up between inspection periods. However, the wooden oak plug was resorted to as the time consumed in washing a set of flues was greatly reduced and a satisfactory job was accomplished.

Conclusion

The Master Boiler Makers' Association is deeply indebted to the mechanical officers who have contributed to this topical report, and, in conclusion, your committee is of the opinion that cinder cutting to some extent is here to stay, it has increased a great deal in recent years under present day operating conditions because the flow of cinders at high velocity through the locomotive boiler can never be entirely eliminated, the cutting action is insidious and takes place over a period of time; therefore, it is not easy to observe and correct before damage is done. The proper thing to do is to anticipate such conditions and set up a strict program for prevention by proper design, maintenance, and operation.

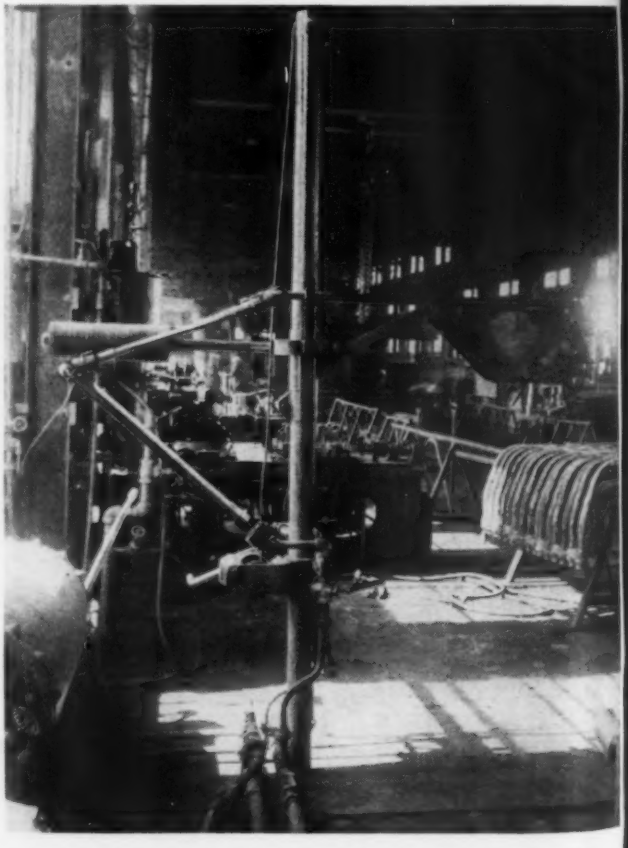
The report was signed by E. H. Gilley (Chairman), general boiler foreman, Grand Trunk Western; E. E. Owens (Vice-Chairman), general boiler inspector, U. P.; S. F. Wentz, special piece work inspector, N. Y. C.; A. P. Robersen, district boiler inspector, Gr. Nor., and Wm. Henry, general boiler inspector, Can. Pac.

Testing Device For Superheater Units

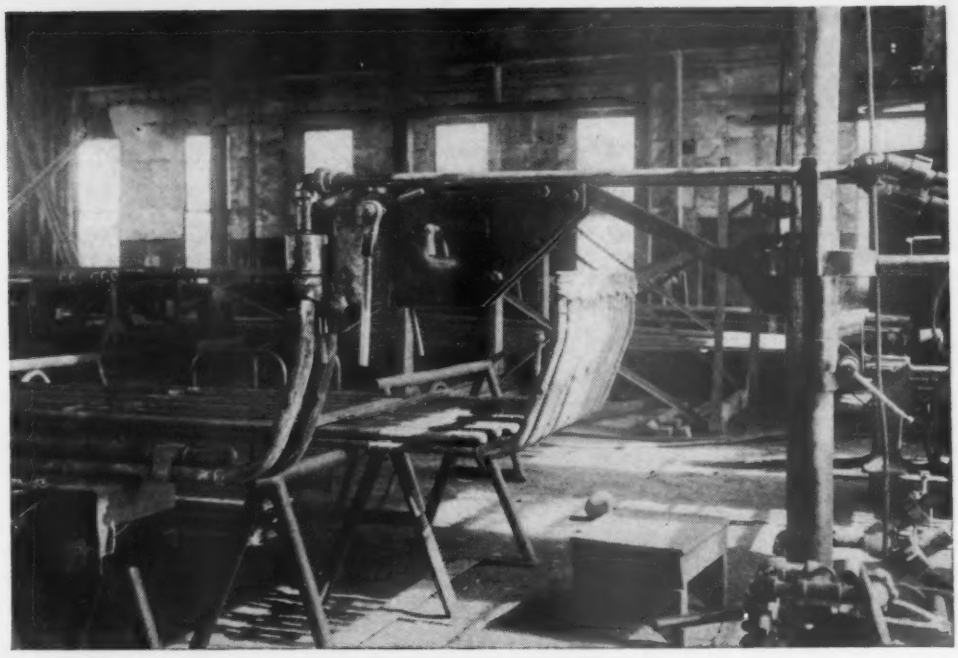
An ingenious arrangement for quickly applying a water test to superheater units before they are reapplied has been developed at the Springfield, Mo., locomotive shops of the St. Louis-San Francisco.

Referring to one of the illustrations, it will be noted that the pressure head at the right of the machine is bracketed to a sleeve which carries a 1-in. round bar extension and counterweights at the left. This sleeve is capable of vertical adjustment on a 3-in. standpipe, 8 ft high, by means of a hand winch and ratchet. When raised to the proper elevation for the particular superheater units being tested, the sleeve may be tightened by setting up a hand screw, which clamps the head firmly in position.

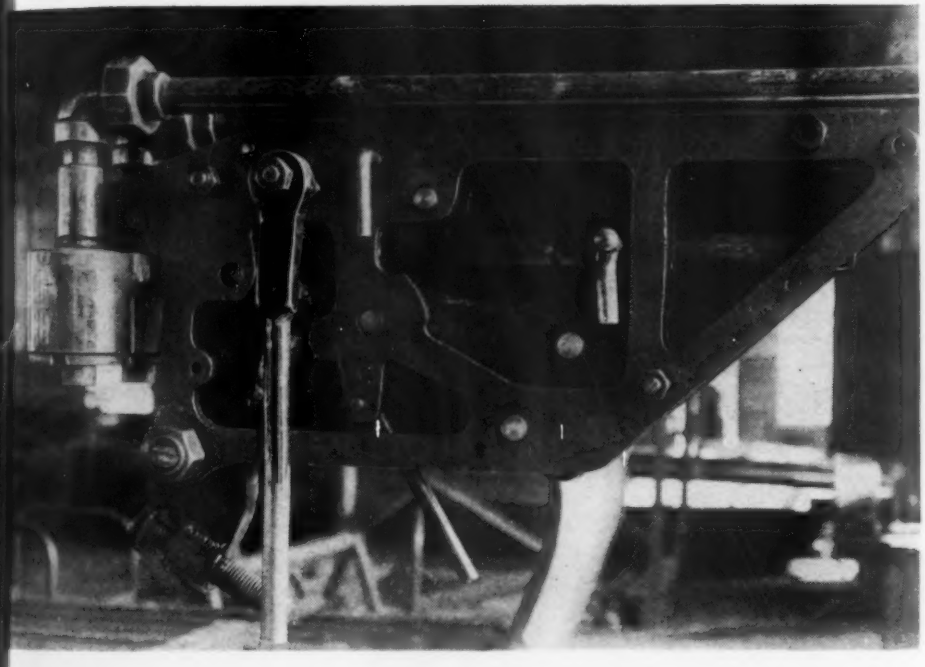
The upper horizontal support of the testing head consists of two lengths of 1-in. pipe connected at the outer end to the pressure head of the machine and at the standpipe end to Barco flexible metallic joint. Six of these flexible joints, in all, are used to connect the double line of short, straight pipe sections which form the A-



The pipe connections to the superheater-unit testing device



Testing head with superheater unit in place



Details of clamping lever arrangement

shape shown and serve to transmit water or air from supply pipes connected to the floor lines to the upper horizontal pipes and head of the test machine. It is obvious that use of the six flexible metallic joints, as installed, permits the testing head to be raised or lowered and still maintain tight steel pipe lines necessary in carrying the heavy water-test pressures.

Water is admitted through one of the pipe lines to the testing head at city-line pressure until the superheater unit has been filled, at which point a valve on the other line is closed and the test pressure raised to 700 lb. by means of a booster pump mounted on the shop wall and arranged to be cut in on the supply line when desired.

The superheater unit is hammer tested, the booster pump cut out, a valve on the outgoing pipe line opened and shop air at 80-lb. pressure admitted through suitable valves and pipe connections to blow all water out of the superheater unit and permit this water to be drained to the sewer. Water delivery to the testing machine is made through a 2-ft. by 5-ft. reservoir to avoid water hammer and give quick delivery of the water.

Particular interest centers about the method of clamping the superheater unit to the pressure head of the machine. Details of the head with side plate removed show the clamping mechanism. Dual outlets in the pressure head are leather packed to make a tight joint with the two ball seats on the superheater-unit pipe.

In operation, the counterweighted pressure head is simply brought down on the unit to be tested and the rocker arm with adjusting screw revolved by hand until the head of the screw comes up under the unit equalizer. Operation of the vertical handle then acts through the series of levers shown to develop an upward pressure on the holding screw at a ratio calculated to be 350 to 1. A quick-acting feature built into this holding head consists of a combination lever and ratchet design which assures both easy and rapid application and release of pressure on the unit equalizer.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Grooving of Girth Seams

Q.—What causes grooving along the girth seams of a locomotive boiler? Why is the grooving found only on the water side of the seam?—J. B. J.

A.—Grooving of girth seams is generally found along the lower portion of the shell at the inside caulking edge of the seam. It is caused by the uneven expansion and contraction of the boiler barrel resulting from the uneven stresses set up because the water in the bottom of the boiler has a lower temperature than the water and steam at the top. In other words, the length of the boiler along the top becomes greater than that along the bottom or belly of the boiler. This results in the boiler "humping" or raising at the center. Repeated actions of this sort weaken the metal at the edge of the girth seam along the bottom of the boiler. This area, being cooler, becomes a hinge point and segregation occurs in the plate. This, combined with the action of the water, causes the plate to deteriorate and grooving results.

The same condition of the plate also occurs along the outside caulking edge but, since there is no water action, deterioration of the plate does not develop to the same extent.

Welding Staybolt Holes

Q.—When repairing staybolt holes in firebox side sheets, is it satisfactory to weld, re-drill and tap new holes, or should sunflowers be used?—L. D. M.

A.—The general practice is to weld a hole only where the maximum oversize of staybolt has been reached and it is desired to reduce the hole in size to accommodate a staybolt of the original diameter. Sunflowers are used to repair side sheets which have cracks radiating from the staybolt holes. Sunflower plugs should not exceed 3¼ in. in diameter and the number used should be limited. A side sheet area requiring an excessive number of sunflowers should be renewed with a welded patch.

Welding Staybolt Sleeves

Q.—Should flexible staybolt sleeves be welded to the wrapper sheet in one or two passes of the electrode?—R. E. N.

A.—One pass should be sufficient because only a seal bond is needed between the sleeve and the sheet. Only sufficient metal to prevent leakage should be applied. The strength or security of the bolt and sleeve is self-contained and does not depend on the weld. Care should be taken to clean the sheet thoroughly of scale and foreign substances, including oil and grease. Sand blasting will be found to be the most effective as well as economical method. Quality of the weld deposit rather than quantity is most important when welding staybolt sleeves.

Applying Heavy Locomotive Springs

A quick and convenient method of applying heavy locomotive springs is now being used with exceptionally satisfactory results at the Decatur, Ill., shops of the Wabash, as shown in the illustration. The Yale lift-truck, which is widely used about the shop for many other operations, in this instance is equipped with a spring-lifting fork made in two sizes or types. The one illustrated is designed for use in applying driving springs to the spring saddles on the main locomotive frame. A similar fork, but with underslung carrying arms, is used to move and lift trailer springs and yokes into place.

Referring to the illustration, the lifting fork is made of two 1½-in. square steel bars, permanently connected by a welded cross piece and designed so that two 48-in. arms rest on the truck platform and have ends designed to hook into two 1⅝-in. holes drilled in this platform. The outer fork ends, 18 in. long, are offset upward 8 in. above the platform level and are spaced so as to support

Yale lift truck equipped with special lifting fork used in applying locomotive driving springs

the driving spring, up-turned lugs on the fork ends keeping the spring from slipping off.

This lifting fork may be easily applied to or removed from the lift truck and is a definite labor-saving device. Formerly, from four to six men were required to hold one end of a long lift bar while the shop crane was being used to insert driving springs in place on the locomotive frame.

For the application of heavy trailer springs and yokes, a relatively low lift is required and the lifting fork used for this purpose is similar to the one described, being used with equally satisfactory results and saving much time and labor. In this instance, the fork arms on the lift truck platform are identical with the other design and hook into the same holes in the platform. The spring support arms are also the same length but offset downward 12 in. to permit inserting trailer springs and yokes at the required low level.

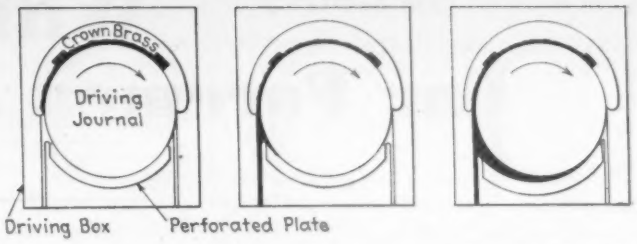
Grease Grooves in Driving Box Bearings*

By S. M. P.

It required about fifty years for us in the mechanical department to become aware of the fact that oil, instead of entering the bearing of an engine truck, pony or trailing truck from the oil hole in the top of the bearing, actually was being pumped out through the centrifugal pumping action of the journal. It would no doubt amaze us if we knew how many thousands of gallons of oil were pumped out of the cellars and wasted onto the ground, before we were willing to accept this as a fact and plug the holes to stop the waste.

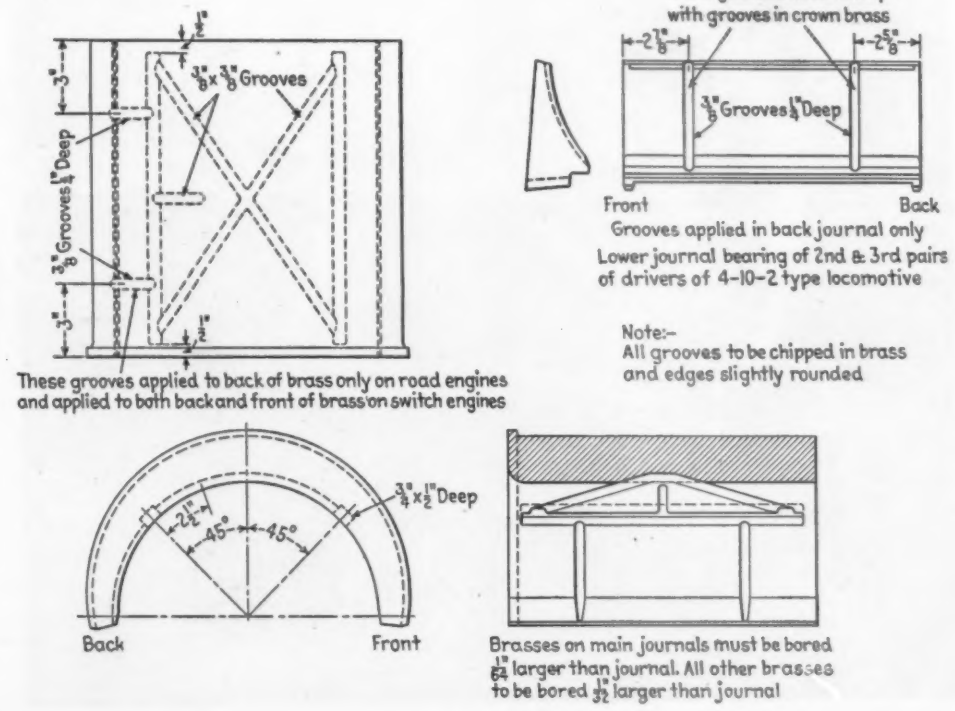
A similar situation exists today when most of our Class I railroads, as well as those who sell locomotive grease cellars, advocate and go to the expense of cutting grooves in driving-box bearings, believing that the grease feeds out of the cellars and enters these grooves, and through these grooves feeds to the journals to lubricate them. These grooves in the driving-box bearing are a means for the grease to get out of the cellar in a way similar to the oil pumping out of the top of an engine, trailer or pony truck bearing, except that the grease does not run like oil.

When bearings are tight and run cool there is a very slow movement of the grease. As the bearings wear and temperatures rise, the movement is more perceptible. The grease that adheres to the journal as it passes up under the bearing is subjected to from 335 to 395 lb. pressure per sq. in. Under pressure the grease will feed out wherever the pressure is relieved. Dowel plugs are sometimes found pressed out onto the top of a driving box. When this happens the cellar will empty itself out on top of the box. Sometimes grooves are lengthened to run out at the hub face of the box, and when this is done you will find that the cellar empties itself at the hub face. Any place where there is a leak in the bearing the grease will come out. Therefore, the grease grooves instead of being a means for letting the grease to the bearing, furnish a means of escape. This might not be so bad if the grease was simply lost but it fills the cavity between the side of the cellar and the driving box. When this is full the additional grease shoves the perforated plate away from the journal and a hot box results. The drawing shows this action as it takes place.



Grease from the grooves is forced between the box and the cellar and results in a hot box

* Operating about 850 locomotives, 21 per cent of which are oil lubricated, the writer's territory showed a record of one million two hundred and eighty thousand miles per hot driving box in the year 1944.


1"
3"
3/8" x 3/8" Grooves
3/8" Grooves 1" Deep
3"
1/2"
These grooves applied to back of brass only on road engines and applied to both back and front of brass on switch engines
These grooves must line up with grooves in crown brass
2 7/8"
2 5/8"
3/8" Grooves 1/4" Deep
Front
Back
Grooves applied in back journal only
Lower journal bearing of 2nd & 3rd pairs of drivers of 4-10-2 type locomotive
Note:-
All grooves to be chipped in brass and edges slightly rounded
2 1/2"
45°
45°
3/4" x 1/2" Deep
Back
Front
Brasses on main journals must be bored 1/64" larger than journal. All other brasses to be bored 1/32" larger than journal

Typical railroad locomotive bearing

With the Car Foremen and Inspectors

Device for Reaming Underframe

An ingenious portable two-wheel reamer buggy, developed at the Bessemer, Ala., plant of the Pullman-Standard Car Manufacturing Company, is shown in the illustration performing some upward reaming operations in a car underframe.

This device consists of reamer with the motor and gear-reduction drive mounted in a steel frame *F* equipped with corner posts telescoping slightly larger corner posts set in the main frame *M* of the machine which is designed with base *B* extending almost to the ground and handle *H* for moving the reamer buggy about the shop with the weight supported almost entirely on the two truck wheels. The electric motor is started and stopped by push-button control from a small control box conveniently located on handle *H*.

The vertically mounted reamer and reamer drive unit is raised and lowered on the telescoping rods by an ingenious lever arrangement which may be either hand or foot-operated. A single forged crank lever *CC* is hinged at *D* in the base of the machine and designed with an extension handle *A*. Straight lever *E* is hinged at *G* on the reamer unit and also pin-connected at the lower end to the knee of crank lever *CC* in such a way that downward pressure on handle *A* gradually raises the reamer-drive unit

Foot pressure is used on the operating handle to finish the reamed hole

General view of electrically-operated two-wheel reamer buggy used for reaming holes in car underframes

and reamer with rapidly increasing pressure as the leverage angle approaches 180 deg.

In operation, this reamer buggy is easily moved by one man into position under the car center sill or frame which is to be reamed and the electrical connection made. Using handle *H* to make slight necessary adjustments of the buggy position, handle *A* is pushed down by hand until the reamer enters the hole which is to be reamed. Further hand pressure downward starts the reaming operation and by that time handle *A* is fairly near the floor and, if desired, the heavy finish reaming may be done by foot pressure on handle *A*, as shown in the second illustration. Raising handle *A* withdraws the reamer from the hole.

Ample power is available in this machine to ream up to ⅞-in. holes which is large enough for by far the great majority of rivet holes in car underframes. In case heavier reaming is required, however, a larger electric motor or more powerful gear reduction unit would be required. The use of this light, flexible and powerful machine eliminates all upward hand reaming under the car.

Markham Wheel Shop On the Illinois Central*

By F. J. Holsinger†

All scrap wheels received at the Markham, Ill., wheel shop of the Illinois Central are put on a standard double-wheel track where they are inspected and marked as to whether they are scrap or second hand. This track leads directly to a stripping press where the wheels are dismounted, the scrap wheels going into an automatic lift that conveys them to a chute 150 ft. long with 10 grates, making it possible to separate steel wheels from cast-iron wheels. These wheels are loaded into cars by a magnet crane to be returned to foundries. This method eliminates hazardous handling by hand.

An axle conveyor that works on the same principle as the wheel chute is used to separate the surplus second-hand axles into rows of different sizes and to discard the scrap axles. The second-hand axles are carried from the stripping press by an electric hoist crane to the axle-lathe bench which will hold 12 axles with enough room on both sides for inspection and the drilling of center holes when necessary. We have a portable clamp that fastens back of the collars with which we use a combination countersink and drill for making the lead holes for recentering.

All axle lathes are equipped with gauges for checking journal length and diameter. The shoulder is cut back for inspection of the wheel seat and for measuring the radius of the fillet. The lathes are equipped with tool-post turrets and permanent tool holders, making it necessary to remove only the tool bits for sharpening. Most of the lathes are equipped with live centers, and those that are not are coated with Stellite. The practice at Markham is to turn all wheel seats, journals and end collars. The wheel seats are turned the same size on the individual axles so as not to confuse the man on the boring mill who handles the micrometer.

All axles are checked for seams and cracks before they are placed on a rack to be moved to the burnishing machine. All center holes are ground on the surface with a portable grinder to remove burrs and roughness before the axles are put into the burnishing machine to have the journals rolled. After this they are again checked for seams or cracks and measurements are taken. Upon removal from the burnishing machine, they are placed on tracks leading to the wheel press to have the wheels mounted.

All new wheels are hauled to the boring mills with a self-loading and unloading truck especially built for this purpose which will haul wheels up to 40 in. in diameter. This truck is easy to manipulate and does away with the hazardous practice of rolling wheels by hand and overcomes the problem of man-power shortage in this particular phase of the work.

The boring mills are checked every Monday morning with a dial gauge and are ground true with a portable grinder fastened to a Davis bar. We find the grinding necessary about twice a year when other repairs are made to jaws. After the jaws have been ground, a pair of wheels is bored, mounted and tested in a gap lathe equipped with live centers to see if the wheel is perfectly true. All wheels are bored within the limits of the A.A.R. specifications and micrometer measurements are marked on wheels and axles to correspond.

The wheels are rolled to the mounting press by press operators who apply a coating made up of pure white lead and linseed oil. The proper mixture of this coating is a very important factor in wheel mounting, as a wrong mixture can cause a good many misfits. We use 12 lb. of white lead to one gallon of boiled linseed oil, as instructed in the manual. This mixture should be tested daily with a heavy liquid hydrometer and made fresh at least once a week as it thickens and, when thick, it will make changes in the wheel pressure.

All gauges used at the mounting press are checked each Monday morning with master gauges and when they are found to be out of gauge, they are built-up with Stellite. An extra recording gauge is kept on hand to be used in case of emergency, and for making repairs needed to the one in use. As each pair of wheels is mounted, the wheel numbers, date cast, capacity and initials of the mechanic boring the wheels are shown on the recording chart in case any checking back is necessary.

The axles are centered by a marker gauge with a dull point so that the center of the axle will not be defaced and, possibly, cause a progressive fracture. We have a separate solid gauge for each class of axle. Guards are put on the journals before the wheels are placed on the axle; they are then rolled into the press where both wheels are pressed on without turning the axle. The axle is pressed into the first wheel and the second wheel is pressed on the axle. After this they are gauged at three points with an overall gauge. The journals are greased and the wheels leave the shop on a standard wheel track for loading by a locomotive crane; or, they can be turned on an air jack in the center of the track and rolled back into the shop to be ground and tested for roundness.

Our wheel press is operated with oil in place of water. We find this much better as it lubricates the valves, keeps the leathers soft and protects the plunger sleeves.

For stripping motor-car wheels, Spicer drives, and other special wheels with gears on axles, we have a jib crane and a monorail with a suspended hoist to handle heavy tools. With this equipment a mounting press can be changed over to serve as a stripping press. This is very helpful as many wheels cannot be dismounted on the regular stripping press.

We are able to reclaim a great many cast-iron wheels that have slid-flat spots by putting them in a Norton grinder. We also grind cast-iron wheels for application to cabooses. All steel wheels for streamlined trains are put through this grinder and balanced.

* An abstract of a paper delivered before the Southern & Southwestern Railway Club at Atlanta, Ga., on September 20, 1945.
† Wheel shop foreman.

New axles are used for passenger service when they are available. When second-hand axles with new dimensions are used they must be tested for cracks with a magnetic testing machine. Wheels with cut or discolored journals must also be so tested. It is my opinion that all wheel shops should be equipped with this equipment and have all axles, both for freight and passenger use, pass through the machine before the wheels are mounted. There are cracks that cannot be detected by ordinary inspection.

In checking axles on Diesel switching engines we found that 59 out of 60 were cracked. The cracks were between the gears and wheel fit; some of them were all the way around the axle and as deep as three inches. This type of axle has been redesigned by doing away with the fillet and cutting a straight taper about ¾ in. in length, equally divided between the gear and the wheel. Later Diesel axles are purchased with the gear dovetailed to overcome the defect. We also have found cracks in our streamlined locomotive axles, but no cracks have been found in the streamlined car axles that have been tested magnetically.

Nearly all steel wheels are bored by one boring mill which is equipped with a large Davis bar. This eliminates chatter by using shorter tools, and works out very satisfactorily in boring wheels of the larger sizes up to 9 in. bore. All coach wheels are turned in a lathe and are taped for size after the wheels are finished; we do not depend on the measuring attachment on the lathe as we bore. All coach wheels are turned in a lathe and are tapes, and it has been proved that if a wheel is out one tape, the smaller wheel must travel 9½ ft. further for each mile. This causes sharp flanges and, in my opinion, also contributes much to hot bearings. All wheels are then placed in a gap lathe for turning the journals and the wheels are tested for concentricity.

A number of wheels have been found with the treads turned that were as much as ⅛-in. eccentric although they were the right tape size. This condition is caused by the material in the wheels being harder in some spots, which is mostly caused by slid-flat spots. These wheels are placed in the grinder and ground true before they are put out for service. Tool holders are made from tire steel and a pin insert tool is used for rough turning which has greatly reduced cutting-tool cost.

All wheels for streamlined trains mounted in our shop are balanced and ground but not turned, as this is done in the Diesel shop where we have a later type machine and the turning can be done without removing the bearings.

Hot Journal Costs

[The following abstract is taken from a paper delivered last year before the Eastern Car Foreman's Association by P. J. Hogan, supervisor of car inspection and maintenance, New York, New Haven & Hartford. We will be glad to publish similar studies which any of our readers may have made.—EDITOR.]

It is a difficult task to tabulate accurately the actual cost of a hot box as each hot box occurs under different circumstances. Factors which must be considered are: the class of engine or train involved; number of cars and tonnage; type and style of trucks; wheels, whether chilled-iron or steel; location of set-out, which determines operating delays; proximity of nearest repair point; back haul required, if any; nature of repairs made; the condition of wheels after removal; condition of journals after removal; and, the disposition made of wheels removed. Additional costs may result from loss through claims for damage to ladings or spoiling of perishable freight. Market losses may be incurred because of delayed train arrivals. Car equipment and roadway damage may result and personal injury costs may need to be considered. All of these factors tend to vary costs in any single case.

In order to estimate the costs of a hot box, a typical journal-failure situation will be considered. The figures will be arbitrary, but we will try to keep them within reasonable limits. As an example let us consider a modern steel box car, equipped with 5½-in. by 10-in. Bettendorf-type trucks and chilled-iron wheels, set out of a 100-car train 20 miles from the nearest repair point because of a cut journal. The assumed delay is one hour which includes switching out the defective car and waiting for clearance from the dispatcher. We shall try to estimate the cost involved from the time the car was set out until it is again placed in train service ready for departure to its destination.

The costs on wheels do not include axles and if the axle removed was scrap it would change each estimate.

Such a car before reaching its destination may be back-

Direct Costs Involved In Setting Out a Car for a Hot Journal

Setting Out Car Enroute	
Fuel—½ ton coal used during 1 hr. delay at $5.42 a ton	$2.71
Brake shoe wear assuming 1/32 in. combined wear per car	2.44
Crew time not estimated (crew is paid on a miles and hours basis in through freight service and a 1 hr. delay would seldom result in any increase in wages)	.....
Cost	$5.15
Road Service By Car Department	
Motor truck, 40 miles round trip at 10 cents per mile	$4.00
Labor—2 hrs. at $1.60 (A.A.R. rate)	3.20
Oil, waste and coolants	.30
Second-hand brass usually used to get car to repair point	.....
Cost	$7.50
Picking Up Car for Movement to Repair Point	
This is usually done by engine and crew in local freight service. As 8 hrs. constitutes a day for the crew the time consumed in picking up car would be part of that 8 hrs. or any overtime. Engine fuel and crew labor	$7.50
Cost	$7.50
Yard Switching at Repair Point	
Placing car on repair track by switcher	$1.08
Removing car from repair track by switcher	1.08
Cost	$2.16
Repairs on Repair Track	
Second-hand cast-iron wheels R. & R. (material)	$.....
Two new 5½-in. by 10-in. bearings less scrap credit	2.50
Two new dustguards and plugs	.12
Waste and oil	.50
Jacking car	1.60
Usual possibility of additional per diem charge	$1.00
Labor on wheels—Includes pressing wheels off and on, boring wheels, handling, all machine shop labor on new or second-hand axles, and removing and replacing wheels in truck as per A.A.R. rates, 4 hrs. at $1.60	6.40
Cost	$12.12
Hot box cost, example 1	$34.43
Variables Affecting Costs	
When second-hand wheels removed are scrap:	
1 pair second-hand wheels applied less scrap credit	$6.70
Plus hot box cost, example 1	34.43
Hot box cost, example 2	$41.13
When new wheels are used in place of second-hand wheels:	
1 pair new wheels less credit for second-hand wheels removed	$15.40
Plus hot box cost, example 1	34.43
Hot box cost, example 3	$49.83
When new wheels are used and wheels removed are scrap:	
1 pair new wheels less scrap credit	$22.10
Plus hot box cost, example 1	34.43
Hot box cost, example 4	$56.53
The average cost of these four examples amounts to $45.48.	

hauled an additional 40 miles because of journal failure and, therefore, the cost of hauling this extra tonnage should be added to the estimates.

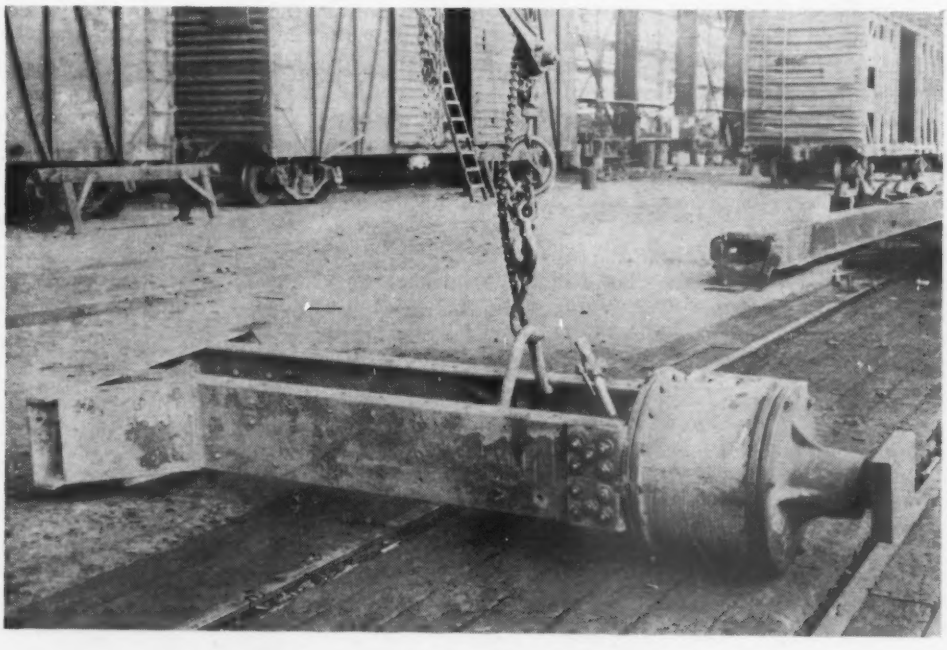
This report is not intended to estimate the cost of an average hot box but is an example of a typical journal failure.

Car-Side Straightener

Among other types of coal-carrying cars, hopper cars are subject to damage when the lading freezes in temperatures below 32 deg. F. and the car side panels are battered and hammered in an effort to unload the coal. The device shown in the illustration has been designed and constructed at the Decatur, Ill., car shop of the Wabash for the specific purpose of pressing these side-panel sheets outward and straightening them again without removing the sheets and usually without even heating them.

The device consists of a well-braced steel post and footing, made of 12-in. channel sections and equipped at one end with an 18-in. by 12-in. passenger air-brake cylinder having a 2¼-in. by 9-in. by 12-in. draft-gear follower plate welded to the end of the piston. The base of this press is 51 in. long, or more than enough to reach across two side posts of the hopper car. Diagonal braces which are welded to the base for stiffening purposes are 18 in. long. The total length of the car-side straightening press, exclusive of the air-brake cylinder, is 6 ft. 6 in.

The pressure head of the air-brake cylinder was removed and a ¾-in. steel head substituted which is bolted to two angle brackets attached to the main frame. A ¼-in. air pipe connection is made to the pressure head of the air-cylinder, the three-way cock, illustrated, being used to admit air to the cylinder as required or exhaust it. A ¼-in. round hanger loop is welded to the device near the center of gravity so that it can be supported from the crane hook. It can then be balanced in a fairly horizontal position when used in the straightening of car sides.



Channel-section steel post and air cylinder used in straightening dented hopper car side sheets at the Decatur steel car shop

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units Brake Application

EMERGENCY APPLICATION (*Continued*)

317—*Q.—What pressure is obtained?* A.—This provides a maximum pressure of 75 lb. However in this handle position emergency valve *10* and its pilot valve *12* are unseated by a cam on the brake valve handle shaft, allowing air from passage *1* and the brake pipe to escape rapidly from passage *1b* to exhaust (*EX*). This provides emergency rate of brake pipe reduction that is transmitted serially to each control valve in the train, operating the emergency portions of the control valves to produce an emergency brake cylinder pressure of approximately 98 lb.

318—*Q.—What movement is effected at the D-22-ER control valve as the result of an emergency rate of reduction?* A.—Referring to Fig. 26, the emergency rate of reduction reduces the pressure in chamber *B*, on the face of the emergency piston.

319—*Q.—The emergency piston moves forward after this reduction. What brings this about?* A.—As quick action chamber pressure on the opposite face of the emergency piston cannot escape through the vent port *t* in emergency graduating valve *30* and port *y* in the slide valve to atmosphere at the same rate, sufficient differential is built up across the emergency piston to compress spring *49* and allow the graduating valve *30* to move far enough on the slide valve to open port *t1* in the slide valve which registers with port *t2* in the seat, allowing quick-action chamber air to flow to the face of vent valve piston *42*.

320—*Q.—What action occurs after the resulting movement of this piston?* A.—Movement of the vent-valve piston unseats vent valve *40*, opening a large and direct passage from brake-pipe passage *1b* to the atmosphere.

321—*Q.—What does the venting of brake-pipe pressure past the vent valve insure?* A.—Insures the prompt movement of the D22-BR control valves on the cars to emergency position due to the serial emergency rate of reduction through the train.

322—*Q.—Describe the continued movement in the control valves brought about by the rapid reduction of brake pipe.* A.—The emergency piston and slide valve move to the extreme right, which carries slide-valve port *t1* out of register with port *t2*, but port *t2* is now uncovered by the tail port in the slide valve so that quick-action chamber pressure remains connected to the vent-valve piston.

323—*Q.—What additional pressure enters into the picture to assist in producing a higher-brake cylinder pressure?* A.—Emergency reservoir.

324—*Q.—How is this brought about?* A.—The emergency slide valve now connects the spring side of the high-pressure valve *44* to the exhaust *Ex*, through passage *h1* and cavity *h2* in the slide valve *29*. This vents air pressure from the spring side of the high-pressure valve, and emergency reservoir air in passage *2*, acting on the outer area of the valve, unseats this valve, permitting emergency reservoir air to flow through passages *3h* and *3f* and eventually to the master controller.

325—*Q.—Through what valve must the emergency-reservoir air pass before reaching the master controller?* A.—The No. 15C double check valve Fig. *32*.

326—*Q.—How is this accomplished?* A.—With the emergency slide valve in emergency position, the air from passage *3f* flows through slide-valve cavity *S* to passage *15*, pipe *15* and the *No. 15c* double check valve. As the emergency reservoir pressure is higher than the control pipe pressure on the face of check valve *4* in the double check valve, developed by the self lapping unit of the brake valve, the higher pressure moves check valve *4* to its opposite seat and flows to the master controller.

327—*Q.—How is the master controller thereby operated?* A.—As described for the HSC brake application, to develop an equivalent pressure in the straight-air pipe on the locomotive and cars and therefore, in the relay pipe *16*.

328—*Q.—How are the FS-1864 and F-1864 relay valves then operated?* A.—To produce the adjusted ratio of brake-cylinder pressure as regulated by the speed governor. In this manner a higher brake-cylinder pressure is obtained throughout the train in emergency application than in service.

329—*Q.—What happens in the event of interrupted circuits, etc.?* A.—In the event that interrupted circuits prevent the high emergency braking pressure from developing normally, the secondary automatic brake system will function to do so.

330—*Q.—What combination of pressures brings about the development of a higher pressure in emergency than is obtained from either the electro-pneumatic or automatic pneumatic service brake application?* A.—The pressures in the emergency and auxiliary reservoirs equalize passage *3* into the displacement reservoir.

331—*Q.—How is this brought about?* A.—At the D-22-ER control valve, the emergency-reservoir air in passage *3h* flows to passage *3b*, *3a* and *3* to the displacement reservoir. Meanwhile the emergency rate of reduction in brake-pipe pressure has caused the service piston and slide valve to move to the extreme left where the graduating valve uncovers the service port *f*, through which auxiliary-reservoir air from chamber *C* flows into passage *3b* and to the displacement reservoir passage *3*, combining with the flow from the emergency reservoir.

332—*Q.—To what valve is the displacement reservoir connected?* A.—To the relay valve.

333—*Q.—Trace the air between the relay valve end and the displacement reservoir.* A.—Displacement-reservoir air flows through passage *3* to the bottom face of double check valve *263* in the application and release portion. The check valve is moved to its upper seat, connecting passage *3* to passage *16c* and *16*, through which the higher pressure builds up in the *16* pipe to the relay valve.

334—*Q.—How does the relay valve then function?* A.—It then operates to develop the adjusted ratio of brake-cylinder pressure controlled by the speed governor, as described under HSC brake application.

Operation of the Independent Brake Valve

335—*Q.—Describe the position of the various operating parts of the independent brake valve in release position.* A.—The cam on the independent-brake-valve shaft *11* engages pusher *68* attached to floating levers *67*. In release position of the brake-valve handle the cam is at its lowest position so that the balance levers float freely and inlet spring *51* holds inlet valve *50* seated, and spring *63* unseats exhaust valve *64*, opening the brake-valve cavity *B* to the brake-valve exhaust *Ex*. Poppet valve *25* is held unseated by dog *15*, controlled from the cam of the brake-valve shaft, thereby opening the independent application and release pipe *20* into the brake-valve central cavity *B*, and thence past the exhaust valve *64* to the brake-valve exhaust. Spring *22* holds valve *21a* unseated, opening the actuating pipe to the atmosphere.

Car-Side Riveting Position

The Wabash is currently engaged in a program of constructing 50-ton gondolas at the company car shops, Decatur, Ill., and the accompanying illustrations show an arrangement for riveting at the position where car sides are assembled.

Special hitch used in handling car side with the overhead traveling crane at Decatur shops

This shop is equipped with the usual long pit and fixed riveting machine, but the pit is not deep enough to permit riveting high gondola car sides without inverting them while pressing the various courses of rivets and, moreover, the riveting pit and shop crane required for its oper-

ation are more or less busy. To meet this condition a riveting position with special equipment was installed, as shown in the illustrations.

The first thing noticeable in connection with this job is that the car side rests under a monorail on the shop floor, being steadied in a vertical position by a brace at either end, bolted to one of the shop building posts. All riveting of top rail, floor rail, bottom rail and side stakes to the sheets is, therefore, done with the riveting crew standing on the shop floor. The Chicago-Pneumatic riveting machine, with a capacity to drive up to ⅞-in. rivets, is suspended from an Ingersoll-Rand 1,000-lb. air-motor hoist and trolley which traverse a 6-in. I-beam, securely supported over the riveting position.

Referring to the combined illustration, the right view clearly shows this pneumatic riveter as suspended from the air hoist and trolley. The center view shows the entire riveting position, featured by location of oil-fired rivet heater *R* on a platform seven feet above the shop floor and about central with the position of car side *S*. Two elevated hoppers *HH* are located, one on either side of the rivet heater, and, each has the side towards the heater cut away so that hot rivets can be easily tossed into the hopper and delivered through a telescoping sheet metal pipe directly to the point where they are being used regardless of position along the car side. The left view gives a close-up of the pneumatic riveter and one of the rivet delivery pipes which is designed with an open collector box on the bottom resting on a small steel table 18 in. high for convenience in picking up rivets. The cushion the fall of the rivets and prevent them from overheating the box.

A few additional details may be of interest. The rivet heater platform is 6 ft. wide by 8 ft. long, or large enough to support the heater and give extra floor space for the operator and a keg of rivets elevated to that position by another air hoist. The rivet hoppers, made of galvanized steel, 40 in. in diameter, are supported by light 3-in. and 2-in. angle iron brackets bolted to adjoining building columns. The upper section of the rivet delivery pipe is 3 in. in diameter and connected through a Barco flexible metallic joint to the cone of the hopper. The lower section, 3½ in. in diameter, telescopes the upper part and is equipped with a collector box at the bottom, as described. Each of the two rivet-delivery pipes may be easily swung and extended to cover one-half of the car side.

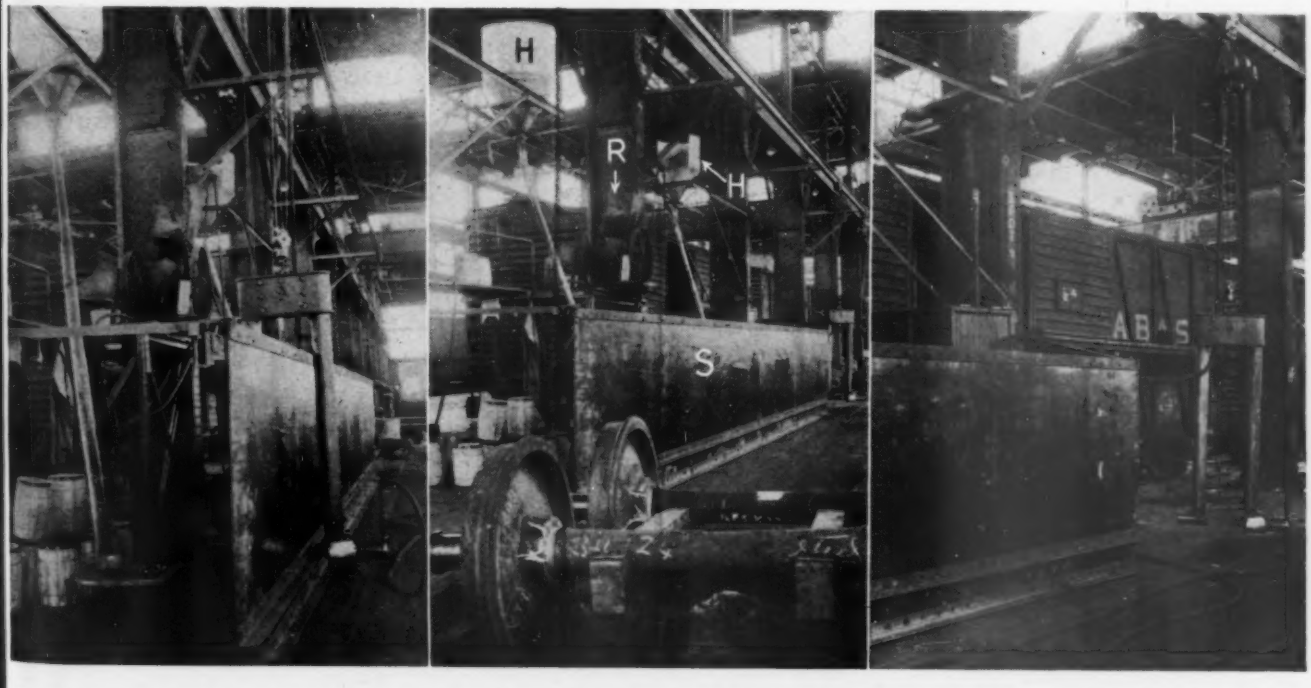
In assembling the gondola car side, illustrated, there are three rows of rivets, namely in the top rail, floor rail and bottom rail. This requires a total of 394 ⅝-in. rivets per car side. These rivets can be driven with minimum delay, using the riveting arrangement and particularly the improved rivet-delivery system and equipment which have been adopted.

Car-Side Lifting Device

A device which assists materially in handling relatively flexible hopper car sides with the overhead crane at Decatur shops is shown in a separate illustration. This consists of a 6-in. I-beam, 16 ft. long, reinforced at the center with a shorter 6-ft. section welded in place for stiffening purposes. A ring connection to the crane hook is also made at the center.

At each end of the beam is a pair of links and built-up, double-plate jaw, pin connected to the links and designed to fit and be applied around the bulb angle on the car side. This double-plate jaw is made of ¾-in. thick steel plates and is roughly 9 in. wide by 12 in. high. The double plates are spaced far enough apart to accommodate a single central lifting plate, and short through bolts and nuts hold the three plates together.

The fit of the jaw around the bulb angle is such that the jaw can hardly slip off when lifting a car side at any angle, but, as an added precaution, the open side of the jaw is covered with a steel guard finger which extends down from the central lifting plate. An upward pull tends to keep the guard finger in place, but a positive lock is provided by insertion of a pin through the three plates. This pin may be easily removed when the car side has been lowered in place and it is desired to remove the crane hitch and lifting jaws.



Car-side riveting position at Decatur shops—Right: Chicago-Pneumatic riveter suspended from mon-rail by I-R pneumatic hoist—Center: Riveting position showing rivet heater *R*, rivet hoppers *HH* and two rivet delivery pipes—Left: The riveter and one of the rivet-delivery pipes ready for operation

Revised Distribution System

Chesapeake & Ohio improvements save both power and material and avoid flood hazards

BY RAISING line voltage, redesigning the substation and simplifying the distribution system at Stevens, Ky., the Chesapeake & Ohio has reclaimed copper, reduced power losses, improved regulation and protected its equipment from floodwater. An additional saving in power is affected by limiting load demand. At this point power is purchased from a utility company at 13,200 volts, 3-phase, 60 cycles, through one meter, and is used to supply both the railroad shop and terminal facilities and residences, stores, etc., in the town of Silver Grove, Ky.

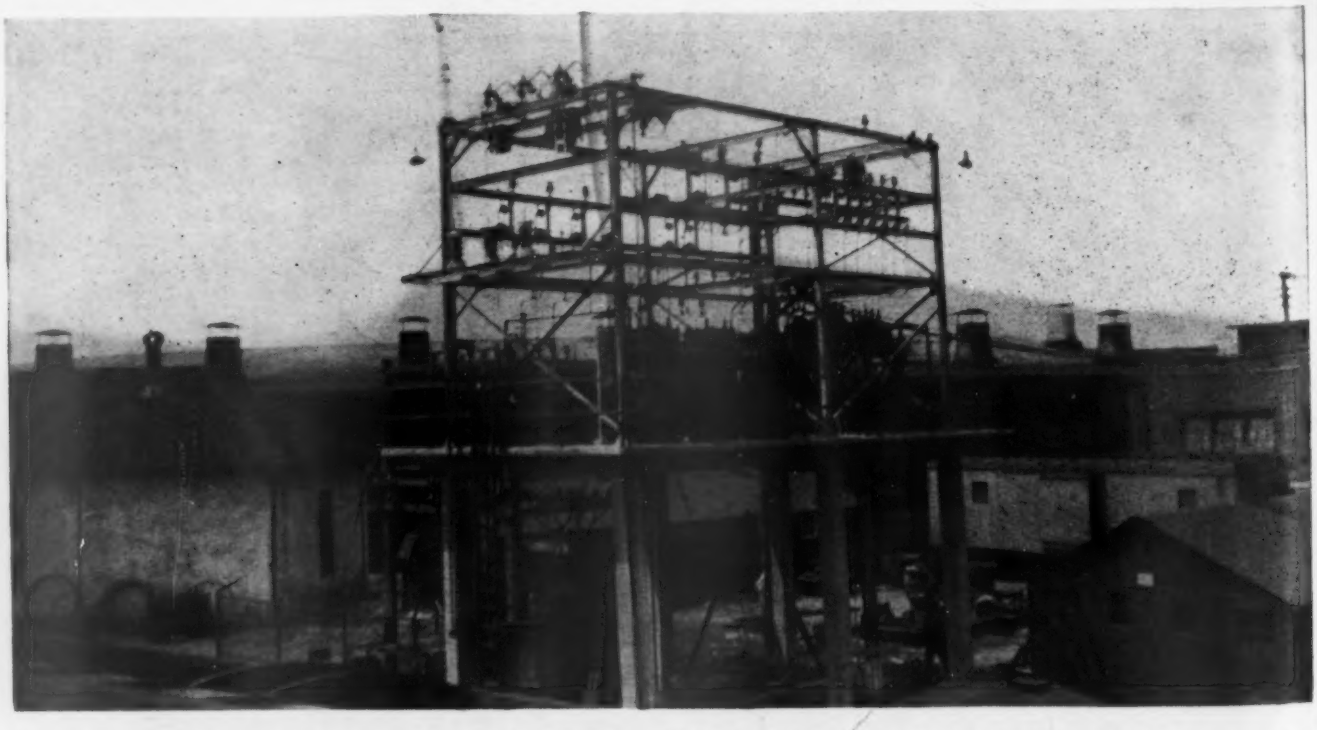
The original transformer equipment consisted of three 333-kva., 13,200- to 440-volt transformers located near the power house at the shops, with heavy cable connections to a switchboard in the power house. From the switchboard, power was distributed over several 440-volt circuits to the various shop facilities near the power house, as well as to several facilities remote from the power house, such as the water pumping plant, floodlights on the transportation yard, lighting in various yard buildings and the town of Silver Grove.

Lighting for the shops was supplied from the 440-volt mains through three 15-kva., 440- to 110/220-volt transformers connected in parallel. Lighting for other facilities was supplied from the 440-volt lines through a number of small transformers suitably located.

Some of the 440-volt lines supplying facilities remote from the power house were of great length and of large size copper. In the case of the line supplying the pumping plant, the distance was so great (approximately 6,500 ft.) that trouble with low voltage led to the necessity of raising the line voltage. Also, increased load in the town of Silver Grove caused overloading of the 440-volt distribution lines and transformers along the streets, making it necessary to take corrective measures.

Old Conditions Required Double Transformation

Conditions at that time made it impossible to go to the expense of revamping the main transformer substation; therefore, it was necessary to provide a bank of step-up transformers, consisting of three second-hand 75-kva. transformers, 440 to 2,300 volts; to convert the lines to the pump house and town of Silver Grove for 2,300-volt operation; and to provide suitable step-down transform-

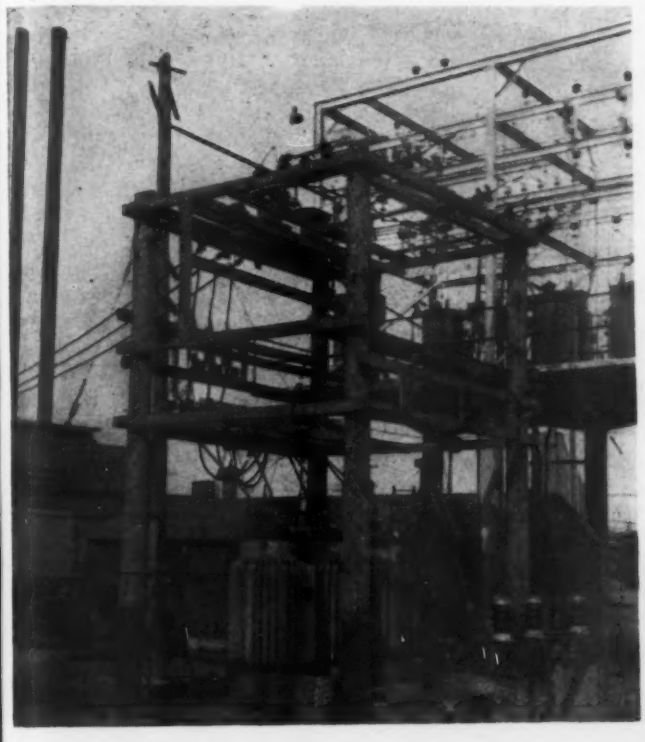


The new substation at Stevens, Ky. is mounted on an elevated platform 17 ft. above the ground and above the highest floodwater on record—No protective fencing is required

ers at the pump house and throughout the town. Under this condition it will be noted that it was necessary to transform from 13,200 to 440 volts, transform a second time from 440 to 2,300 volts, and finally transform from 2,300 to the final operating voltage.

The inefficient arrangement outlined above continued in operation for a number of years. A system-wide power study and efficiency program, which included an investigation of the conditions at Stevens, resulted in an appropriation to cover new transformers, substation equipment and other apparatus required to provide a more efficient and satisfactory arrangement.

Design of the new electrical layout incorporated the reduction of excessive transformer capacity; the supply of shop and remote facilities through separate transformer



The old substation with new one shown in the background

banks; the conversion of 440-volt lines to 2,400 volts for supply of remote facilities; the elimination of retransformation where practicable; and a general simplification of the power distribution system.

Timber Structure Replaced With Steel

A new steel substation structure was erected in place of an old timber structure that was in very bad condition. In the old substation arrangement, the three 333-kva. transformers were mounted at ground level and were completely immersed during the 1937 Ohio River flood, the water at the location of the substation being approximately 17 ft. deep at flood crest. In order to avoid possible damage from future floods, the new steel substation structure, transformers, etc., were mounted on a reinforced concrete platform, the top of this platform being 17 ft. above ground level.

The transformers used at the new substation are three 150-kva., 13,200- to 480-volt supplying power for shops and nearby facilities; three 100-kva., 13,200- to 2,400-volt transformers supplying remote facilities and the town of Silver Grove; and one 50-kva., 13,200- to 120/240-volt supplying shop lighting.

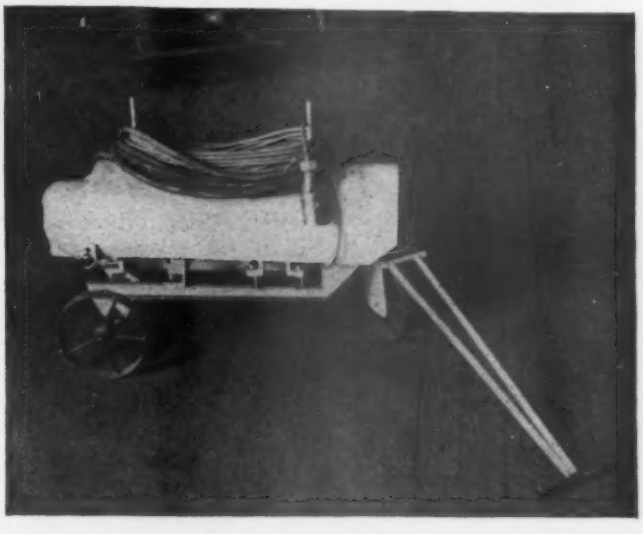
Two oil circuit breakers were installed at the substation, one for the 2,400-volt circuit to the town of Silver Grove and one for the 2,400-volt circuit supplying other remotely located facilities. Power and lighting facilities not located near the shops are now supplied from a 2,400-volt line through suitable transformers. This arrangement permitted the installation of relatively small size copper and the removal for other use of a large quantity of heavy copper cables, formerly used in the 440-volt distribution lines.

Also incorporated in the substation apparatus is a demand limiting device, which automatically disconnects a 75-hp. water-pump motor from the line during short intervals when the demand reaches the maximum specified in the power contract, thus avoiding penalties for excessive demand.

The original three 333-kva. main transformers, three 75-kva. step-up transformers and several other transformers that did not fit into the new arrangement were removed. An aerial ground wire was also supplied to all overhead lines for better protection from lightning.

Locomotive Circuit Tester

The truck-mounted, motor-generator set shown in the illustration was designed and built by electrical workers in the Omaha, Neb., shops of the Union Pacific. It is used in the erecting shop to supply 32-volt d.c. power to locomotives in the shop which are not under steam or are without headlight generators. With power supplied from this set, all necessary tests can be made on circuits,



Portable motor generator set for supplying 32-volt, d.c. power to locomotives in the erecting shop

headlights, cab and marker lights, cab-signal and train-communication equipment.

The set consists of a 440-volt, three-phase, a.c. motor, direct-connected to a Pyle National, Type M06 generator. It is operated from the shop power outlets which are used for welders and other portable machinery. The three-wheel mounting of the set makes it easily portable and the drip-proof cover protects the set from liquids and mechanical damage.

Fluorescent Lighting for Cars

By William W. Garstang *

A discussion of the relative merits of power supply systems using vibrating type boosters and inverters

It is now possible to obtain lighting systems which will enhance the beauty of railway cars and also give passengers more light without increasing battery load. Fluorescent lamps have made a significant contribution toward better lighting, but difficulties have been encountered in taking advantage of these benefits, most of them arising from the conversion of the electrical current. During the war, however, new devices have been developed which simplify railroad installations. The situation has been further improved by the introduction of new types of fluorescent lamps. They can now be obtained in lengths as great as 96 in. (8 ft.) with instantaneous starting. Another recent development is the circular lamp, opening up new types of applications.

An example of fluorescent coach lighting on the New York Central

Conversion systems may be divided into four types:

1—The voltage doubler, which steps up 32 d.c. to 64 d.c. volts, from which (twenty) 14-watt fluorescent lamps may be operated and individually controlled.

2—A special system designed to operate the new 93-in. cold-cathode lamps. This is the simplest, electrically, of the four, and is capable of changing any input d.c. voltage to a.c.

3—A system similar to No. 2, except that recently-developed "slimline" lamps are operated in series. These are "thin" lamps ranging in diameter from ¾ to 1 in. and in length from 42 to 96 in. They are operated without starters, and offer the same instant-starting feature as do cold-cathode lamps. Operating them in series simplifies the wiring system, and through special switches, individual lamp control is possible.

4—An arrangement for changing low d.c. voltage to a.c. for operating 30-watt lamps in parallel.

Each system has its advantages, depending on the economics of the particular application, passenger preferences, and the type of electrical installation.

The voltage doubler, which offers very high efficiency with individual lamp control, shows perhaps the greatest promise for railway coach use. The 15-in. length of the 14-watt lamps, to which it is particularly adapted, is suitable for individual seat lighting. Since 20 lamps may be operated by one converter unit of this type, and there are 40 seats in the average coach, only two converter systems are required for seat lighting. Aisle lighting may be handled with 40 of these lamps arranged in a continuous strip.

The voltage doubler system also has wide application for diners and club cars. It makes possible the construction of small, compact power-conversion equipment and allows for the use of multiple power-conversion channels, so that in case of power failure of one unit, only a small percentage of the total lighting is lost. In a diner, for example, four voltage doublers, running the light load, would permit the use of eighty 14-watt lamps, which could be arranged artistically in three rows down the center and on either side of the car (20 over each row of seats and 40 down the aisle). This would mean an overall consumption of about 1,500 watts, allowing for all loss factors in the fluorescent system.

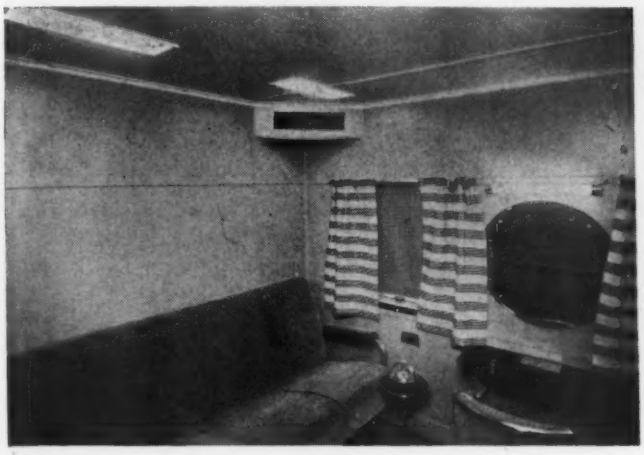
Since 14-watt white fluorescent lamps are currently rated at 485 initial lumens per lamp, the overall illumination provided would be 80 x 485, or 38,800 lumens,

A type of lighting which may be accomplished with either long or short tubes

* President, Electronic Laboratories.

equal to 25.8 initial lumens per watt. This would produce an illumination of about 24-30 foot-candles without greatly increasing accepted incandescent lighting loads. Incandescent lamps offer far lower lighting levels, since they are based on lamps (25-watt, 60-volt) having an output of 285 initial lumens per lamp or only 11.4 per watt.

Another example of the use of fluorescent lighting, even where low lighting levels are desired, as in Pullman cars, is that of "black" (ultra-violet) light directed at carpeting, safety signs and upholstery and drapery. These are illuminated, for purposes of decoration, safety



An application of fluorescent lighting in a ladies' lounge

marking or identification, by dyeing or painting the objects with fluorescent material. Fluorescent materials have the advantages of giving off visible light when irradiated by ultra-violet light.

Black light may be furnished most efficiently by special fluorescent lamps covered by a glass filter to eliminate the visible spectrum and allow only the invisible ultra-violet to penetrate the tube. Such lamps are quite efficient with phosphorescent chemicals and in exciting fluorescent dies and paints. An example of effective black-light utilization is provided by the Santa Fe's El Capitan where carpets were dyed with special fluorescent dies to provide illumination at floor levels.

In planning illumination for compartment-type cars, it should be noted that since these are closed off from the aisle, a high-level continuous strip light arranged in the ceiling above the aisle can be used, and will produce a very practical and decorative effect. Slim-line lamps may readily be adapted for this purpose.

It might be pointed out, at this juncture, that there is a definite need for a low-wattage, smaller-size fluorescent visible light operating on 64 volts which could be used for individual berth illumination in Pullman cars. Six to ten-watt fluorescent lamps operated by a voltage doubler would be most suitable for this application. The development of such lamps would open the Pullman field to individual fluorescent lighting.

The vibrator-type voltage doubler consists of a vibrator and a group of condensers, the latter being charged in parallel and discharged in series by means of the vibrator. The efficiency of this system under full load is about 95 to 98 per cent, which is higher than any other conversion means known at this time. A typical unit weighs only about 12 lb. and has a capacity of about 300 watts. Most significant of all, it requires less battery current for a given light output, and the vibrators last 2,500 hours, or as long as the lamps. Parts are relatively inexpensive to replace. Wiring is simplified, since the car body may be used for the ground return.

System No. 2, designed to operate the new 93-in. cold-cathode instantaneous-starting tube can be used on railroads having voltages ranging from 32 to 600. About 800 volts are needed to operate two of these lamps in series and 1,600 are needed for operating four lamps in series. About 1,500 volts are needed during the two-lamp starting cycle. The high voltage needed for these lamps is obtained through the use of a step-up transformer and vibrator in combination. Advantages of the long, cold-cathode lamp include the elimination of many fixtures and considerable wiring, more even distribution of light, and the absence of annoying flicker when starting. This is especially important in 600-volt electrified railways which cross other tracks and switching points, causing frequent interruptions in circuit. Wiring is simplified, also, because no starting switches or other auxiliaries are necessary. The output is 22 lumens per watt, or twice that of an incandescent lamp in the same circuit.

System No. 3 is particularly well suited to railway lighting since it provides the highest lumen output through the use of 42-in. slimline lamps. Forty lumens per input watt are obtained, or over three times that from standard incandescent bulbs used for the same purpose.

Automatic voltage regulation is provided over an input range of 28 to 40 volts, insuring constant light output. Other similar conversion equipment is available for 64- and 110-volt cars.

Ten to 14 lamps (42-in. slimlines) may be operated per power unit, three to four power converters being required per car. Individual reactors and starting switches are entirely eliminated.

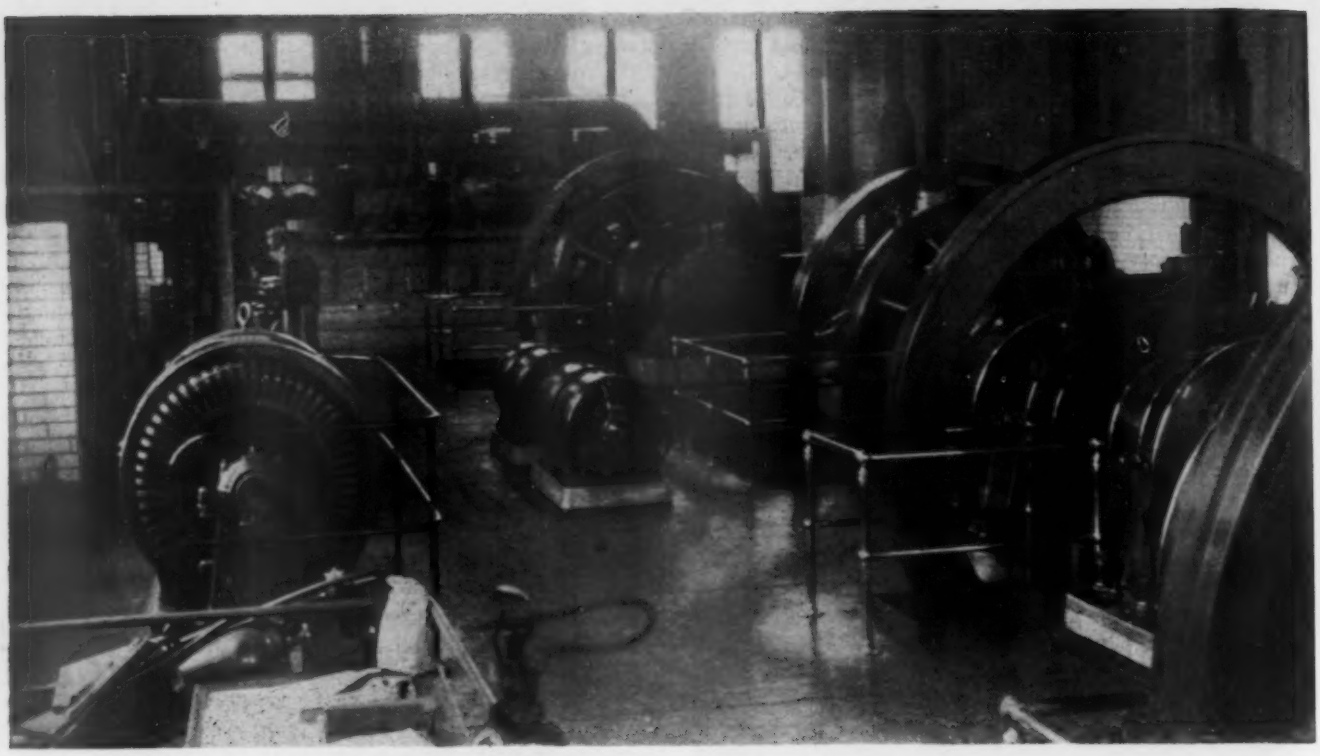
System No. 4, which operates sixteen 30-watt lamps in parallel, allows individual control of lamps, and offers 27 lumens per watt, but, because of the added wiring needed and the individual reactors required for each lamp, is a more costly system.

Because good lighting is so important in transportation, the use of fluorescence is certain to increase in the future. Installations such as those illustrated herewith demonstrate the high levels of illumination obtainable through its use, not to mention the greater eye-appeal and the artistic interior design possibilities offered by straightline and circular lamp construction.

* * *

Westinghouse Photograph

Measuring insulation resistance, an important part of a preventive maintenance program—Since electrical insulating materials are non-conductors only when dry and clean it is important to keep all equipment dry and clean as accumulations of dust and dirt not only contribute to insulation breakdown but they operate to increase the motor temperature through restrictions of ventilation

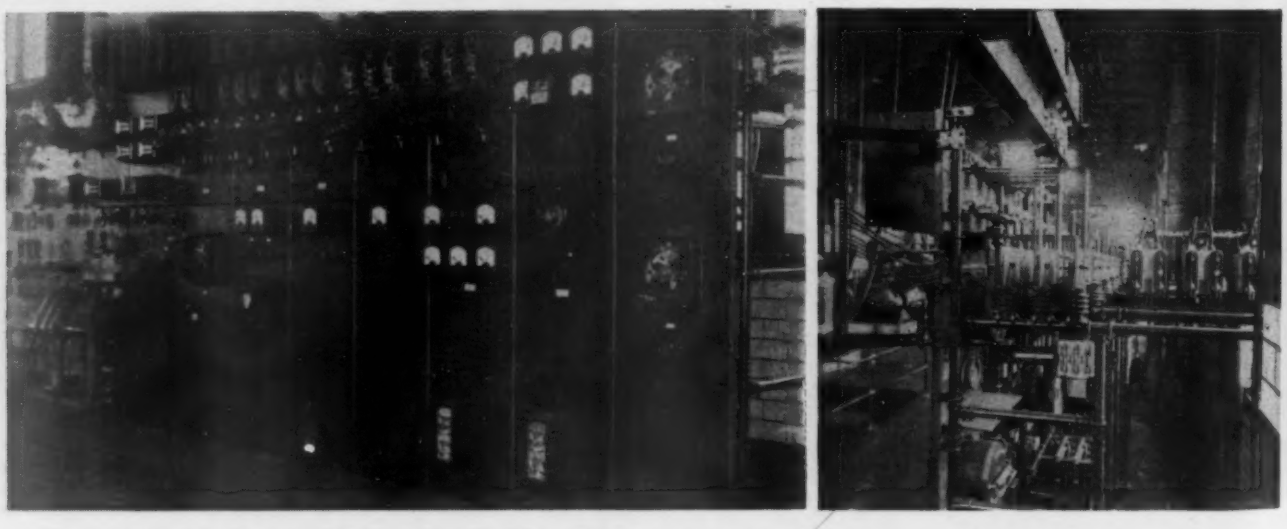


The power plant, showing the Diesel engine in the background

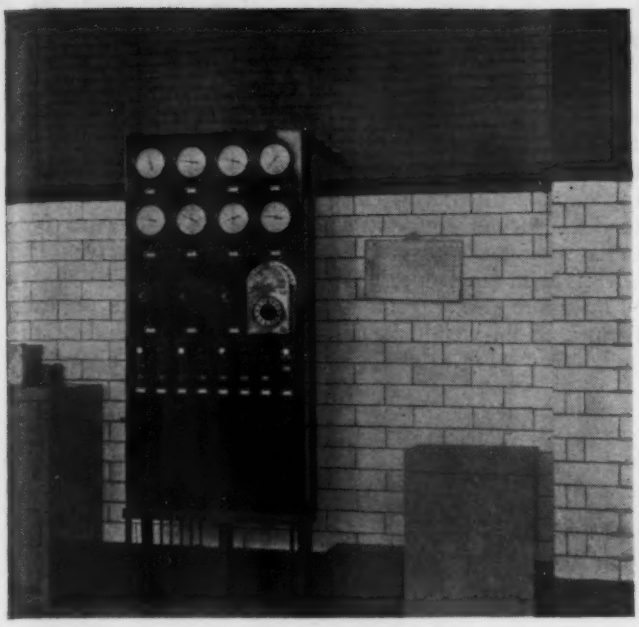
Stationary Diesel Power Plant

Rock Island makes estimated saving of $24,000 a year by replacing steam with Diesel unit

Most of the electrical power for the Chicago, Rock Island & Pacific shops in Silvis, Ill., is now derived from a 1,125-kw. Diesel-driven generator which is replacing a 360-kw. Corliss engine-driven generator with rope drive. No power is purchased and the complete equipment includes in addition to the Diesel unit, a Curtis steam-turbine driving a 480-volt, 600-kw. 8-power factor generator,



Left: The main switchboard—Right: Back of the switchboard showing the connection with the overhead bus bars



Engine gauge panel

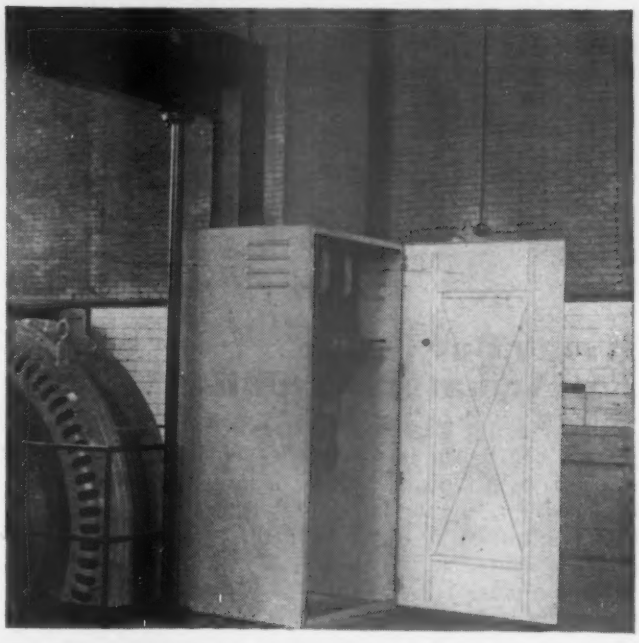
a 500-kw., 230-volt d.c. generator driven by a Buck-eye high speed piston valve engine, a similar 250-kw. d.c. generator with similar engine drive, and a 300-kw. reversible motor generator set.

The Diesel unit was installed because more power was needed and because the old engine was obsolete. The turbine and motor generator set are normally used at night when the load is light. The Diesel and one of the d.c. generators are used in the day time. The estimated reduction of cost of operation affected by the change is $24,000 per year. This is made up largely of fuel cost.

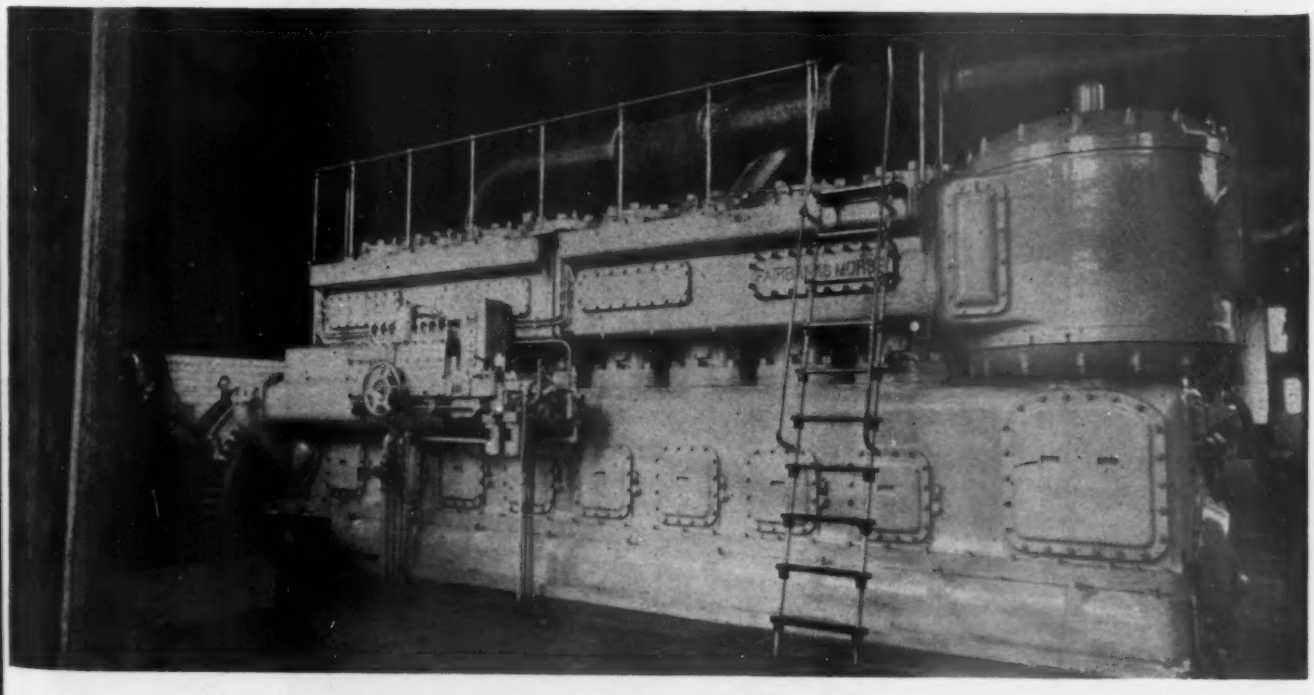
The new engine is an eight-cylinder model 33-E 16 by 20 Fairbanks-Morse Diesel engine. It is rated 1,600 hp., runs at 300 r.p.m. and is directly connected to a three-phase 60-cycle 480-volt a.c. generator rated 1,125 kw. at 0.8 power factor. A direct connected exciter unit is used for field excitation.

Current from the generator is carried to a floor-mounted cubical enclosed circuit-breaker and because the currents are large they are transmitted from the circuit-breaker to the switchboard by means of overhead bus bars. These bus bars are enclosed in a perforated metal casing and are run overhead as shown in one of the illustrations since the basement below the engine room is somewhat crowded with existing piping and did not provide much headroom. For the same reason, the exhaust pipe and air intake pipe are shown above the floor and high enough to permit easy passage way.

Accessory to the Diesel engine are heat exchangers for jacket water and lubricating oil. A 5-in. pump driven by a 10-hp. motor circulates the jacket water through the engine and through the heat exchanger. A 5-in. pump with a 20-hp. motor is used to circulate the raw water



Circuit breaker cubicle with enclosed bus bars brought out at the top



The engine is rated at 1,600 hp. and is direct-connected to a 480-volt, three-phase, 1,125-kw. generator

which may be obtained from the existing spray pond or from an existing well, the latter being equipped with a deep-well turbine. A third 5-in. pump is used as a standby for either the raw water or the soft water, and the piping arrangement permits its being cut into either system. These three split-case pumps with the heat exchangers are located in the basement of the building adjacent to the foundation of the engine.

The pond which constitutes one of the two sources of raw water is a storage reservoir for the water supply system for the entire terminal and is used as a cooling pond for the condensers in the power plant and after treatment the water is used for feed water in steam boilers and for locomotive tender tanks. Its summer excess of heat is dissipated by spray nozzles on the return system. The well water offers a temperature advantage for use through the Diesel heat exchange but it must be wasted after use as it is too hard for re-delivery to the spray pond.

Another engine auxiliary is the gauge-panel which includes pyrometer equipment and starting stations for the various pumps that are used with the engine. The push-button stations are all of the indicating type which show the operator at all times which pumps are in use.

Two new panels were added to the power switchboard. These include a new voltage regulator for the Diesel engine and one for the steam turbine which is retained as a standby and for the night load.

Weigh Bar For Armature Banding

Tight bands for traction armatures are assured by a simple and convenient method developed in the Union Pacific's shops at Omaha, Neb. The armature to be banded is placed in a banding lathe, as shown in Fig. 1, in which it can be turned by the lathe motor. The banding wire is taken from a reel on a stand shown in the foreground through a pair of friction blocks on the top of the stand, to a clamp at the pinion end of the traction armature shaft as shown in Fig. 2. The armature is then turned and the banding wire is guided along the shaft to the guide plate shown close to the armature in Fig. 2. This plate is secured to an arm which in turn is mounted on the shaft.

As the first turn of banding wire is applied to the armature, the banding clips are applied. These are shown in Fig. 2. One loop of the banding wire is carried over the tension pulley. The space between the ends of the banding clips is filled with closely spaced turns of wire, and then the wire is wound in widely spaced loops to the commutator end where it is again clamped securely. The wire is then cut from the spool.

To assure even tension of the proper value on each turn, a 35-lb. weight is first hung at the left end of the weigh bar (Fig. 1). A chain hoist, shown above the man's head in Fig. 1, functions as a fulcrum and permits leveling of the bar during the tensioning operation. The distance from the chain block support to the weight is four times the distance from the chain block support to the tension pulley support at the right end of the weigh bar. The rope block at the extreme left end of the bar

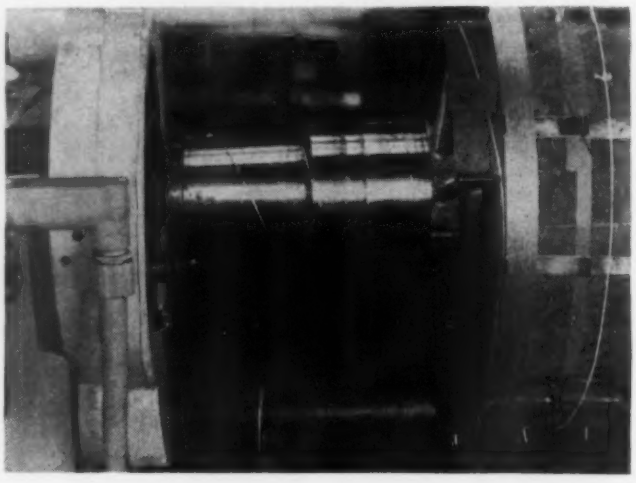


Fig. 2—A close-up of one end of the traction motor in the banding lathe showing how the banding wire is applied

Fig. 1—The weigh-bar at the upper left applies tension to the pulley in the center over which is run one loop of the banding wire

keeps the weight from falling in case the banding wire should break.

The armature is then rotated in both directions to make two passes of the tensioning loop across the bands. The 35-lb. weight is then replaced with a heavier one, a 120-lb. weight being used for the lower band and a 100-lb. weight for the top band of a Type D-7 motor. The bands on the commutator end are similarly applied.

Although band wire breakage is infrequent, it is imperative that the operators wear goggles during the banding operations. All armatures are rebanded at 250,000 mile intervals.

CONSULTING DEPARTMENT

Selection of Transformer Locations

Why are apparently similar sets of transformers sometimes installed in vaults and sometimes on poles or pole platforms? What factors govern the choice of installation?

Can you answer the following question? Answers should be addressed: Electrical Editor, *Railway Mechanical Engineer*, 30 Church Street, New York 7.

We are experiencing much trouble with dirty cooling coils and evaporators on our air-conditioning equipment. Some of this trouble comes from neglect and a great deal from dirt or bad order filters. Would it not be possible to improve this condition by using centrifugal type filters or dust collectors such as are used on locomotive air pumps?

Non-Flammable Cooling Liquid May Offer Added Advantage

The most important factors affecting the choice of the location and method of mounting of a set of power transformers are the desirable proximity to load centers, the special circumstances of the area to be served, the voltage, the rating, method of cooling, type and quantity of the cooling liquid, proximity of combustible materials, the availability of fire-proof or fire-resistive enclosures, and the standards of the local electrical inspection department.

In spite of all electrical protective devices, transformers are a potential source of fire hazard and their live wires a constant menace to the life of careless workers and unqualified persons. No protective measure, therefore, is too elaborate to provide for the protection of life and property in operating transformers. Transformers operating at higher than 600 volts are subject to more rigid restrictions than those operating at 600 volts or less.

Insulation breakdown causes intense heat to be developed, evolving dense smoke, especially in oil-filled transformers whose oil may become ignited and boil over. Mistaking the smoke of coil insulation for fire and pouring of streams of water usually aggravates conditions and causes heavier losses. In view of the foregoing, it is advisable to isolate transformers by installing them in fire-proof vaults or outdoor substations where the existence of such stations is consistent with safety in thickly populated regions and their location will not interfere with firemen. Evidently, in an economical design, the point of power transformation and load center are placed as close together as local circumstances will permit. When not isolated by elevation, transformers and their lines should be kept beyond the reach of unauthorized persons by an enclosure bearing a warning sign indicating the highest voltage within the enclosure.

Transformers filled with a "liquid that will not burn" such as inerteen or pyronol, present several advantages over transformers filled with a "liquid that will burn" such as oil. They do not require costly vaults but should be installed away from wall openings and combustible building parts. A wire grill enclosure covers the requirements in most cases. They are desirable where installation space is at a premium. The possibility of locating this type of transformers comparatively closer to load centers results in better voltage regulation and considerable saving on the length of feeders of large size. Direct mounting on walls without an intervening space is avoided to prevent damage by electrolysis or charring caused by leakage currents. Wooden or preferably angle iron separating brackets are used as supports in mounting transformers on non-combustible walls. Oil-filled transformers of 25 kva. each or less than 75 kva., total rating may be installed indoors without a vault or fire-resistive enclosure if a concrete basin at least 6 in. deep is provided to hold the oil contents of the largest transformer and combustible materials and parts of the building are not within danger of igniting. The oil contents in gallons together with the kva. rating, voltage of each winding, and supply frequency should be stamped on the nameplate of each transformer. When not installed near combustible material, a transformer of 10 kva. or less may be installed in a building without a vault or fire-resistive enclosure. When local conditions necessitate the use of oil-filled transformers on the roof of a building or under a sidewalk adjacent to a building, they must be enclosed in a fire-proof vault.

For practical reasons of safety, continuity of service, and economy, transformers of over 600 volts and their high tension wires should be kept outside the building, even in central station practice wherever practicable. Where installed indoors by special considerations or permission, the location of the vault should be as close as possible to the point at which high tension wires enter the building. Provision should be made for the adequate ventilation, damming up or drainage of oil and water, ample space within the enclosure for easy access to parts, and secure locking to keep out unauthorized persons. When the total capacity of transformers in a vault does not exceed 100 kva., a door sill high enough to dam up all the oil in the vault may replace the drainage system. Transformers rated at more than 25 kva. and using a "liquid that will not burn," must be provided with a metal pan or basin large enough to hold the cooling liquid of the largest transformer. The foregoing may be eliminated if provision can be made to absorb the gases produced by arcing or discharging such gases into a chimney or flue through a pressure relief vent. All live parts must be enclosed or isolated where they may present a potential source of hazard.

In outdoor installations, the distance between the building and transformers is largely determined by the amount of oil contained in the largest transformer which may be involved in a fire. The high tension wires are so distanced from buildings as not to be a fire hazard or, in case of a fire, become a source of hazard to firemen fighting the fire with hose streams.

R. G. CAZANJIAN

NEW DEVICES

Car Wheel Grinder Has Increased Capacity

In 1939 the American Car and Foundry Company, New York, made available a car-wheel grinder for the tread grinding of mounted wheel pairs on centers, the original design of which has been installed in a number of railroad shops since that time. Changed conditions with respect to the sizes of wheels to be handled have dictated several design changes in this machine which are now offered in the machine being delivered on current orders.

The original machine was described in the *Railway Mechanical Engineer* for August, 1939, page 326. The present model embodies the basic principles of design of the original machine in which the motor-driven grinding heads are mounted adjustably on bracket extensions of the bedplate and grinding-wheel spindles mounted parallel to the treads of the wheels. The entire abrasive wheel and motor assemblies are retractable from the working position to effect a clear path through the machine for wheel pairs. This feature of design makes it possible to locate the machine in any desirable position in the shop layout.

The tailstocks of the present machine are heavier in construction and retain the same principle of bed plate mounting as well as the eccentric mounting of the tailstock spindles. The throw of the spindles, however, has been increased to accommodate a greater range of machine capacity for where the original machine accommodated car wheels of from 28 in. to 37 in. diameter the improved machine can handle all sizes of wheels from 24 in. to 45 in. This feature is of special interest to roads with Diesel motive power.

The motor equipment of the present machine consists of two 25-hp. 1,800-r.p.m. alternating-current motors for driving the alternating-current motor for the feeder motor for rotating the work. All motors operate on 220-440 volts.

The machine is supplied with two 30-in. by 2¼-in. grinding wheels of the purchaser's specifications for either chilled or rolled-steel wheels.

The wheel-tread grinder occupies a floor space approximately 11 ft. by 25 ft. and weighs 28,000 lb. in working order.

Silicone Insulating Varnish

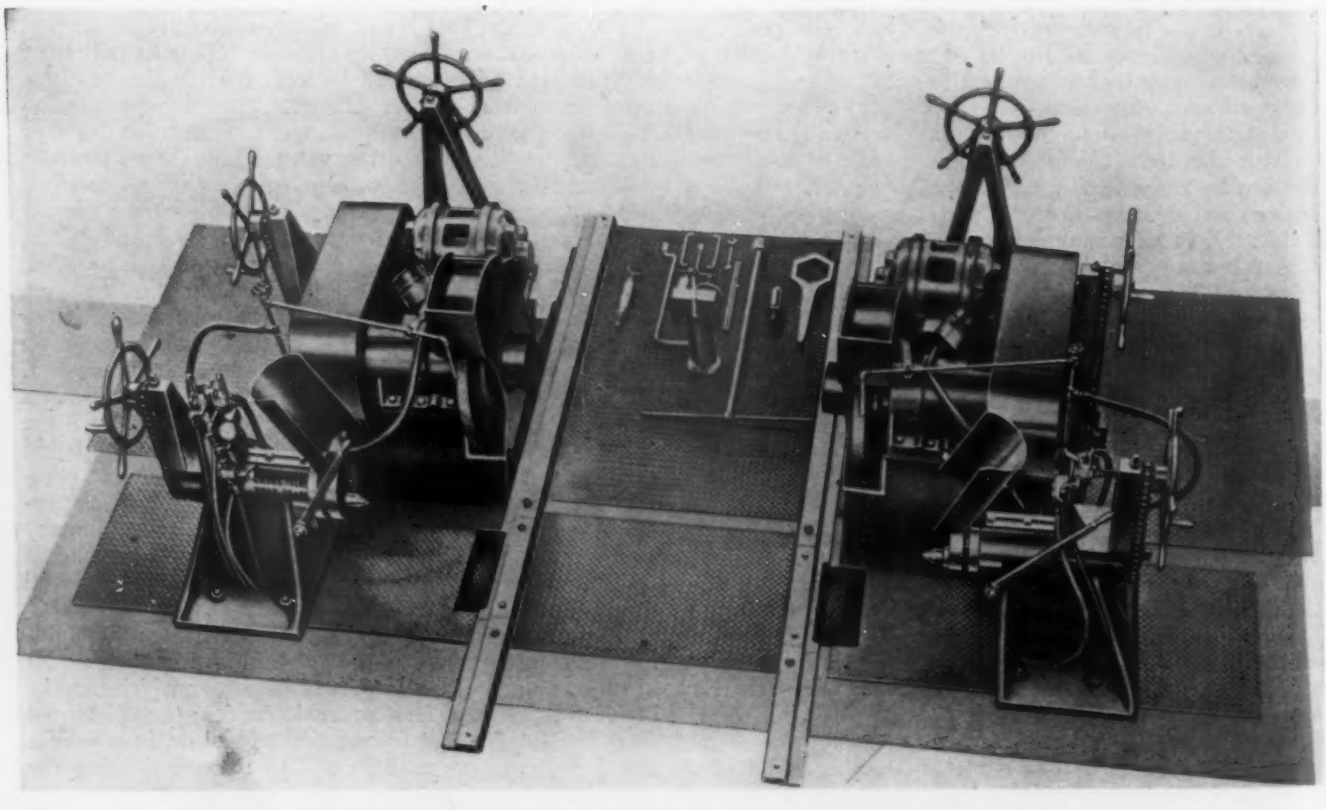
A heat-stable, waterproof varnish for impregnating electrical equipment, which cures at 300 deg. F., is now being produced by Dow Corning Corporation, Midland, Mich. It is known as DC-996.

Electrical equipment wound with silicone insulating materials and sealed by impregnating with DC-996 will have the high order of thermal stability and the retention of the waterproof characteristics of silicone insulation. Silicone insulating materials impregnated and bonded with DC-993 are available through leading distributors of electrical insulations. DC-996 can be cured at temperatures obtainable in ovens now used for curing organic varnishes.

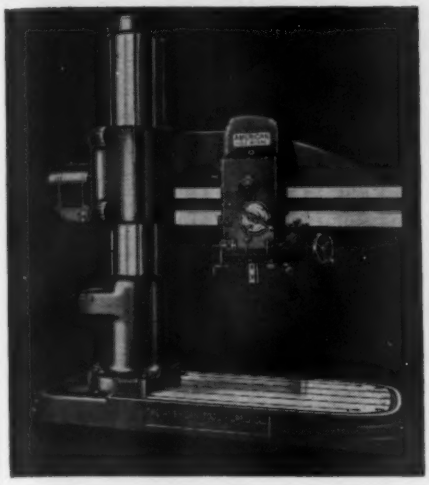
Another advantage of the new silicone varnish is that electrical equipment can be baked fully assembled without damaging the commutators or the slip rings. The temperature required to cure DC-996 does not affect shellac-bonded mica or core plating.

American Radial Drill

The design of a new model radial drill made by the American Tool Works Company, Cincinnati 2, Ohio, introduces a patented spindle drive that is said to have added so materially to the efficiency of radial-drill functioning that the production possibilities with this type of machine have been increased. The head is mounted on rollers for easy movement along the arm and all manual controls are centralized and concentrated so that complete operation may be effected from the most natural operating position. Safety features for protecting both the operator and machine have



The American Car and Foundry Company's wheel grinder now handles wheels from 24 in. to 45 in. diameter

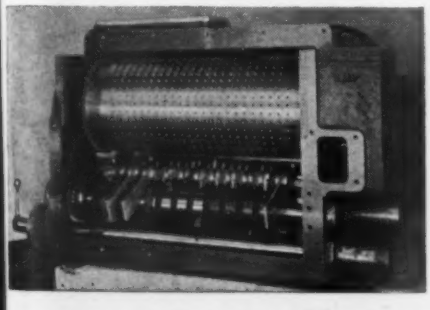


Radial drill with Double Lo-Hung spindle drive

been included as well as provisions for simplifying functional controls to guard the operator against mistakes in manipulation and from undue fatigue from his efforts.

Automatic Control for Vertical Turret Lathes

The Bullard Company, Bridgeport, Conn., has recently announced the availability of the Bullard Man-Au-Trol in combination with the 30- and 36-in. vertical turret lathes of the Cut Master design and, when conditions permit, the application will be extended to the 42, 54-, 64- and 74-in. sizes.



This drum, through dogs and contact levers, is the determining factor in the selection of machine functions—The levers actuate hydraulic valves when the drum is indexed 1/40 revolution for each phase of the automatic cycle

The Man-Au-Trol is an electro-hydraulic control system which can be pre-set to perform any number of separate functions up to a maximum of 39 for each of the two heads of the machine. The machine is pre-set by machining a piece, by manual control, and as each function of each head is completed the automatic control is locked. Upon completion of the machining operations for this piece of work the machine may be changed over to automatic operation and successive pieces duplicated without any manual control on the operator's part.

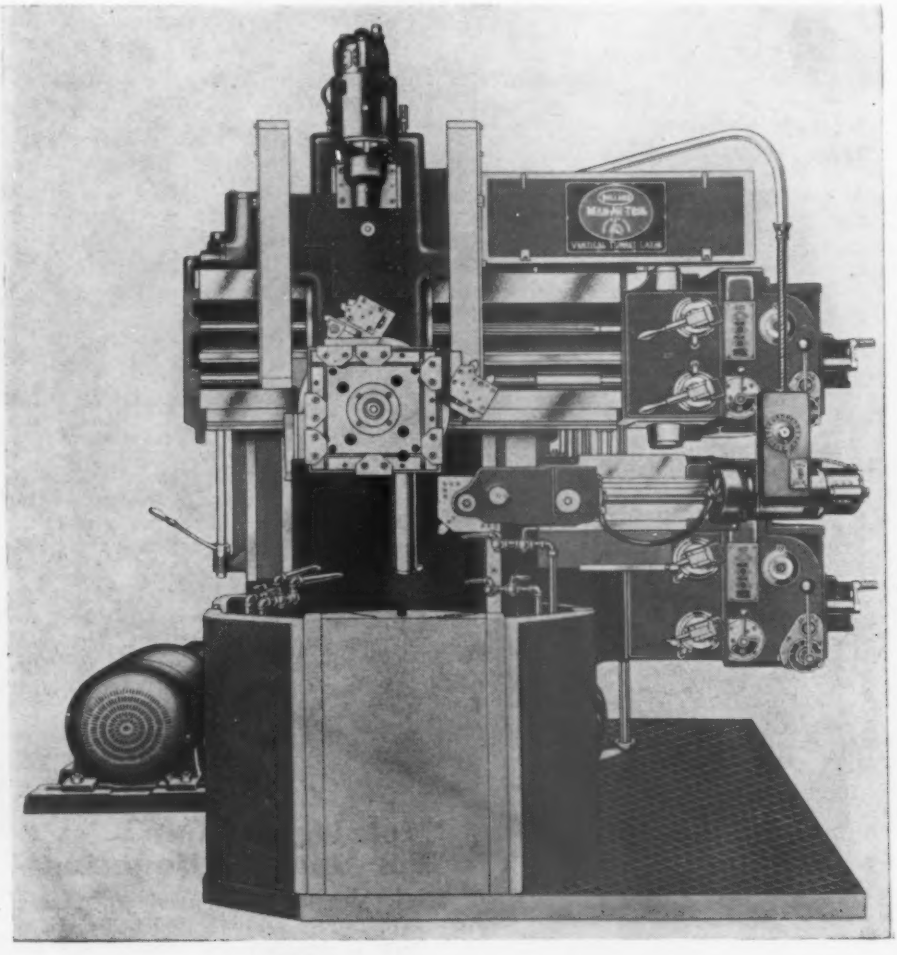
When operating as an automatically controlled machine the automatic control may be thrown out, at any point in the cycle, and the machine used in the conventional manner by manual control. It may then be returned to automatic control without having disturbed the tooling sequence.

The Man-Au-Trol consists of two basic control elements, one, functioning electrically, has control over the beginning and end of each phase of the automatic cycle; the other, operating hydraulically, acts to select the operations which make up each phase of the automatic cycle.

The electrical element is made up of a frame carrying 20 pairs of parallel wires, on each pair of which is a sliding contact that is clamped to one of the wires and free to slide on the other. The wire to which the contact is clamped is equipped with a micrometer adjustment by means of which the position of the sliding contact is established. Since the feeding of tools into the work is one of the functions controlled by this electrical element and tolerances of ten-thousandths are required the necessity of means of accurate positioning of the sliding contacts is obvious.

The heart of the hydraulic selector system is a drum having 40 rows of holes extending the length of the drum. Dogs are set in these holes which, as the drum rotates, actuate levers controlling solenoid-operated hydraulic valves. These valves start and stop the various machine functions. At the end of the drum are 40 electrical connections leading to the electrical control element. As each of the 40, or less, dogs in the drum contacts a control lever a pair of wires in the electrical element are energized. Behind the banks of wires in the case of the vertical head, or below the bank in the case of the horizontal head,

Electrical controls determine the beginning and ending of each phase of the automatic cycle—A bank of switches behind the wires make contact with sliders as the head moves



36-in. Bullard Man-Au-Trol vertical turret lathe

there is a support with a row of 20 switches, one for each of the 20 sliding contacts. The hydraulic element selects, starts and stops the operation function through the control drum. The movement of the head, upon which is mounted this 20-switch bank, causes contact to be made with the slider on the energized circuit. When this takes place the drum makes another 1/40 revolution and a new set of hydraulic control valves operate to end or begin certain machine functions.

Each of the heads of the machine can be set to perform a maximum of 39 functions and settings can be made so that both heads may be in operation at the same time with provision made for prevention of interference. Tool wear is compensated for by the ability to make micrometer adjustments of the electric stops.

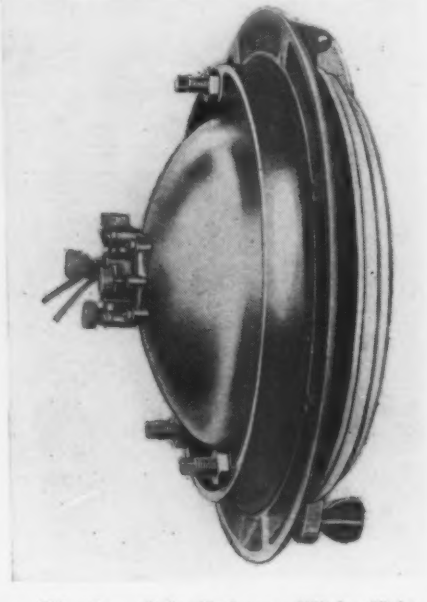
The vertical turret-lathe drive consists of main driving motors with auxiliary motors for the main and side heads. Two types of tables are available, either with three-jaw combination or four-jaw independent chucks. The three-jaw chucks are either manually or hydraulically operated, as desired.

Two general types of drive are available —the sliding gear and the change gear— and, depending upon the drive type and the motor speed, the spindle speed ranges are from a minimum of 3.3 r. p. m. to a maximum of 321.3 r. p. m. There are 16 feeds, in geometrical progression, varying from .0007 in. to .125 in. for each spindle revolution. Each head has independent feed works and the feeds are the same for both heads.

Flush Type Headlights

A headlight designated as Type NH for flush installation in a vertical surface such as required for streamline locomotives or cars has been made available by the Electric Service Manufacturing Company, Philadelphia, Pa. Because of the permanent installation of the body, provision is made for independent training of the beam and for that purpose the reflector shield, together with the reflector and socket, may be adjusted by three threaded brass studs.

The unit is mounted in a cast-iron ring having a steel back. The cast-aluminum front door is fitted with a moulded glass lens. The glass mirror reflectors are mounted on pads with backs protected by steel shields. Gold or crystal reflectors are optional. Sockets are designed for 100- to 250-watt, 32-volt lamps and are furnished either with a focusing device or pre-focused lamps.

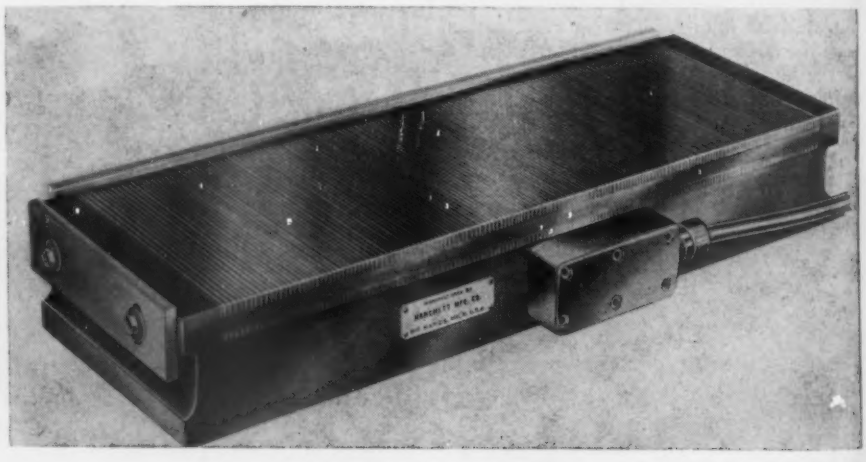


Side view of the flush type NH headlight

Magnetic Chuck With Laminated Top Plate

A laminated top plate of all-steel construction has been added to its line of electromagnetic chucks by the Hanchett Manufacturing Company, Big Rapids, Mich. Pole sections traverse the entire width of the chuck top. Laminations are composed of magnetic steel ⅛ in. thick and non-magnetic steel 1/32 in. thick. By utilizing all-steel top-plate construction, the entire top plate can be hardened. Because of the fine spacing of the poles, the smallest parts can be held without difficulty and a 22 per cent greater magnetic surface is available.

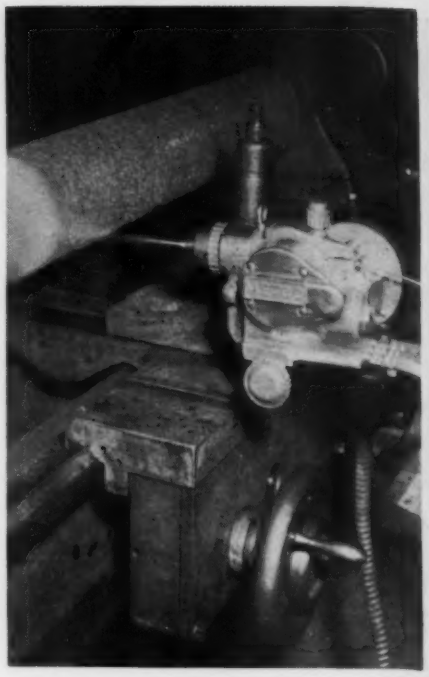
The coils are protected carefully from moisture. In addition, the installation of these coils in the chuck is arranged so that the magnetic flux will be transverse to the length or opposing the action of the grinding wheel or cutting tool thus reducing the possibility of work slippage. At present, this laminated top plate is available in the following sizes: 6 in. by 18 in., 6 in. by 24 in., 8 in. by 25 in., 8 in. by 36 in. and 8 in. by 48 in. Other sizes will soon be made available.



Laminated top plate magnetic chuck

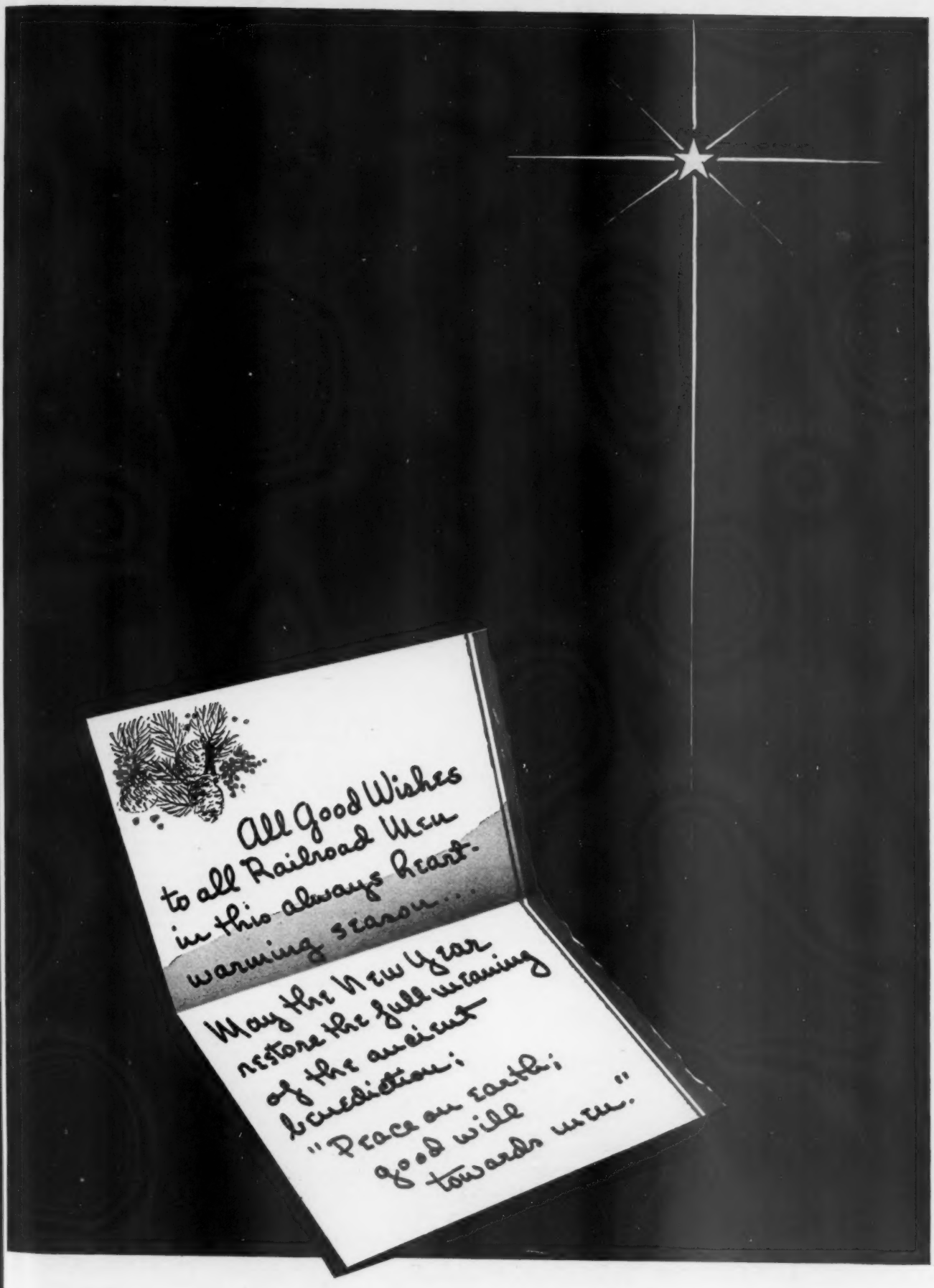
Metal Spray Gun For Machine Mounting

The Metallizing Engineering Company, 38-14 30th Street, Long Island City 1, New York, is manufacturing a metallizing gun designed for heavy-duty, continuous operation. This unit, known as the Metco Type-Y metallizing gun, meets the demand for a metal-spraying gun that can be used for production and other heavy-duty metallizing jobs instead of just for intermittent operation. Its general construction, performance and other features are geared for mounted, mechanical operation, rather than for hand use. Its features include the use of 3/16-in. wire which, when combined with an acetylene pressure of only 15 lb. per sq. in., more than doubles any previous spraying speeds.



Metallizing gun built for heavy duty continuous operation

Because it is designed without regard to the weight and size limitations necessary for the hand gun, the new gun is much heavier and more rugged in construction. Gears, worms and bearings are several times larger than any used previously. The gun has fluid lubrication and a built-in force-feed pump which has no parts to wear assures an adequate supply of lubricant to all bearings regardless of operating position. The gun is non-sensitive to gas- and oxygen-pressure variations of as much as 10 lb. either while lighting or while spraying.



ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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NEWS

A. A. R. Mechanical Division Letter Ballot Results

As AUTHORIZED by the General Committee of the A. A. R., Mechanical Division, the recommendations of various committees for changes in the standard and recommended practice of the division were submitted to letter ballot in the form of 25 separate propositions, in Circular D. V.-1090, dated August 24, 1945.

On the basis of letter ballot returns, it has been announced that Propositions 1, 3 and 4 are being held in abeyance pending further consideration by the General Committee, because of the substantial negative vote and the reasons advanced therefor. Propositions 2 and 5 to 25, inclusive, have been approved by the A. A. R. and are effective January 1, 1946.

Car Department Officers' Association—A Correction

F. E. CHESHIRE, president of the Car Department Officers' Association, whose picture in military dress appears on page 481 of the November *Railway Mechanical Engineer*, had attained the rank of Colonel some time before his return to civilian status as noted on page 479. G. R. Andersen, vice-president of the association, became superintendent car department of the Chicago & North Western a few months ago. His title was incorrectly given on page 481 as assistant superintendent car department.

Some P.R.R. Shopmen Choose C. I. O. Union

THE United Railroad Workers of America, Congress of Industrial Organizations, has supplanted the Brotherhood of Railroad Shop Crafts of America, Pennsylvania System, as the Railway Labor Act Representative of P. R. R. boilermakers, molders, power house employees and railway shop laborers, according to results of a recent election which has been certified by the National Mediation Board. P. R. R. machinists, blacksmiths, sheet metal workers,

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Alton	10[1]	1,000-hp. Diesel-elec.	American Loco. Co.
Central of New Jersey	5[2]	4,500-hp. Diesel-elec. frt.	Baldwin Loco. Works
Pennsylvania	10[3]	6,000-hp. Diesel-elec. pass.	Electro-Motive
Virginian	4[4]	500-ton electric	General Electric Co.

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Southern Pacific	50[5]	Caboose	American Car & Fdry.

FREIGHT-CAR INQUIRIES

Southern	1,000[6]	Automobile	

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Baltimore & Ohio	8[7]	Sleeping	Pullman-Standard
Boston & Maine—			
Maine Central	16[8]	Coaches	Pullman-Standard
	4[8]	Restaurant-lounge	Pullman-Standard
	4[8]	Coach-smoking-lounge	Pullman-Standard

PASSENGER-CAR INQUIRIES

New York Central	214[9]		

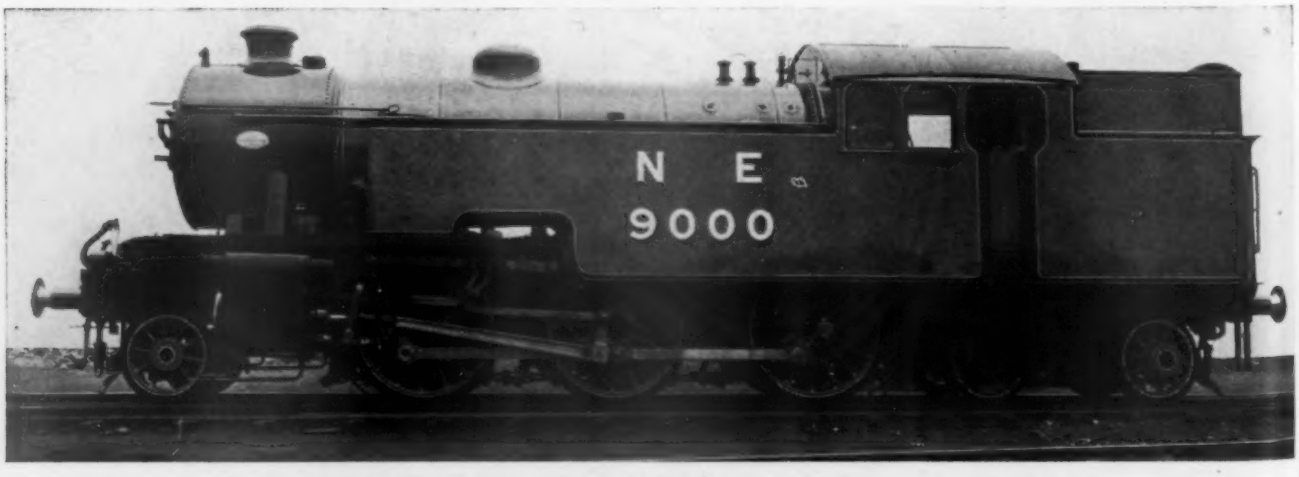
[1] Purchase authorized by Federal Judge Philip L. Sullivan. The order will consist of eight locomotives for $87,138 each, and two train-heater, boiler-type locomotives at $93,262 each.
[2] Purchase price, subject to tests, approximately $1,877,500.
[3] Each locomotive will consist of four 1,500-hp. units coupled together with control cabs at both ends.
[4] Motor-generator type, for delivery in 1946. The locomotives will have a short time rating of 8,000 hp. and a continuous rating of 6,800 hp. The weight on drivers will be 500 tons and the starting tractive force 260,000 lb. based on 26 per cent adhesion. Continuous tractive force at 15.75 m.p.h. will be 162,000 lb. Two 4,000-hp. motor generator sets, mounted within the cab structure, will supply energy to d.c. traction motors geared to the 16 driving axles under the two-cab unit. The motor generator sets will work on the 11,000-volt, 25-cycle overhead contact system, with which the Virginian line is equipped. Power is supplied by coal-burning power plants. The locomotives will be used to haul 10,000-ton coal trains on heavy grades. They are geared for a maximum speed of 50 m.p.h.
[5] For delivery early in 1946. The cars will have bay windows and will cost approximately $317,000.
[6] Bids closed.
[7] Each car will have 16 roomettes equipped with single bed, lavatory and toilet facilities, and four double bedrooms, which will be convertible into suites. The cars are scheduled for delivery in the third quarter of 1946.
[8] To be of lightweight stainless steel and to cost approximately $2,000,000.
[9] For 14 trains. Bids closed.

Notes:

The *Chicago, Rock Island & Pacific* has received authorization to purchase 53 passenger cars and 250 automobile freight cars at cost in excess of $5,600,000. The passenger equipment includes 16 day-chair cars, 11 chair-night coaches, 2 parlor cars, 3 parlor-observation cars, 5 sleeper-room cars, 4 dining cars, 5 baggage cars, 3 room-lounge cars and 4 cars of a type not yet specified.

The *Gulf, Mobile & Ohio*, through its board of directors, has authorized the purchase of 24 Diesel-electric locomotives, 20 of which will be for freight service, two as road switch engines and two 2,000-hp. for streamline passenger-train service.

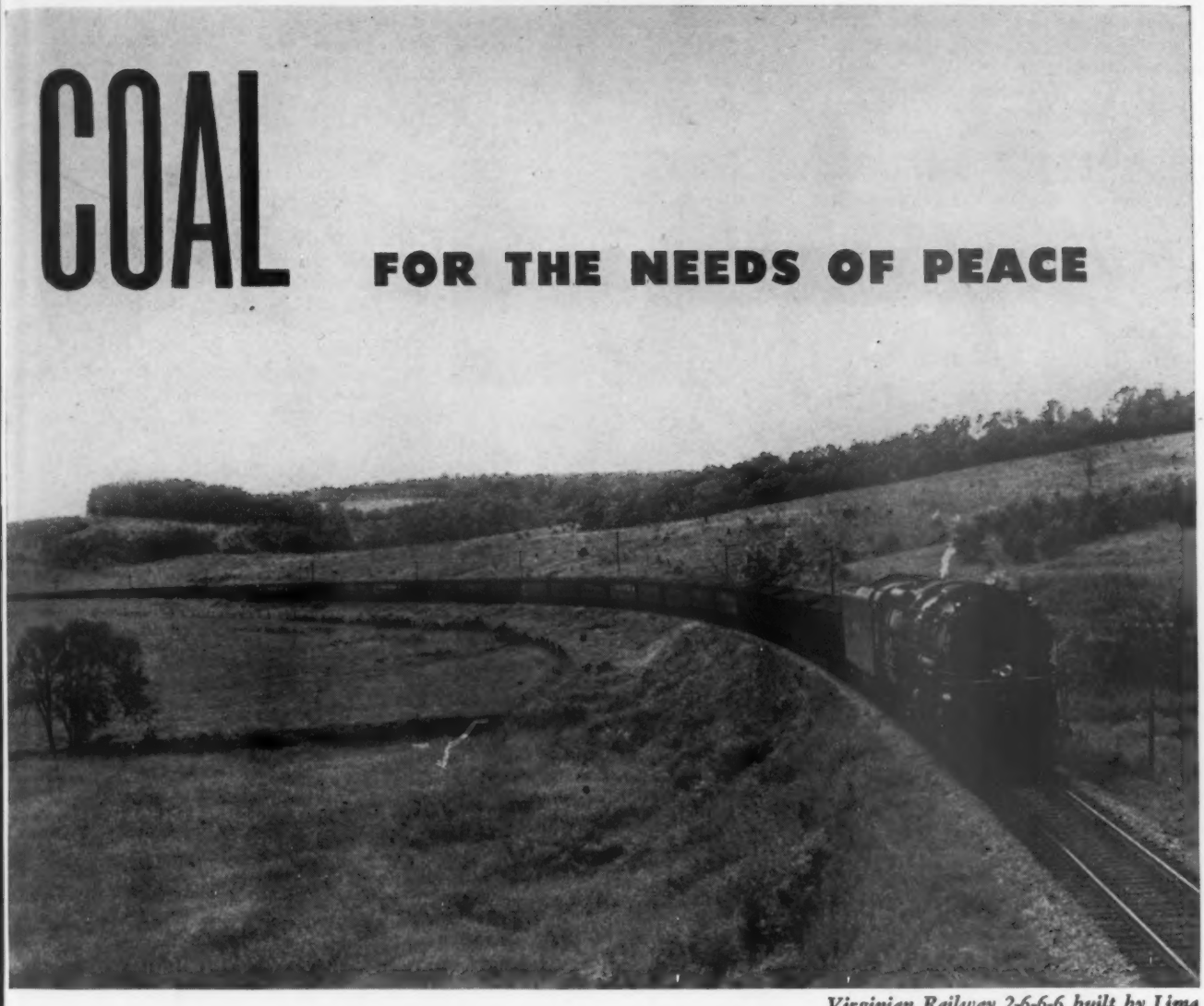
The *Missouri-Kansas-Texas* has completed plans for the purchase of six 1,000-hp. Diesel-electric switch engines at a cost of $475,500. These locomotives will be used to Dieselize switching operations in the Dallas, Tex., terminal completely.



A London & North Eastern Class L1 locomotive

The locomotive is the first of a new design to be built in Britain since VE Day; the first in the railroad's five-year plan for the construction of 1,000 new locomotives, and the first British tank locomotives to be fitted with electric head and tail lamps and electric lighting in the cab—It has two outside cylinders 20 in. by 26 in., a boiler pressure of 225 lb., and a tractive force of 32,000 lb.

COAL FOR THE NEEDS OF PEACE



Virginian Railway 2-6-6-6 built by Lima

The Lima-built 2-6-6-6s The Virginian Railway placed in service to handle the war's tremendous coal traffic demands, are already speeding fuel to meet the needs of reconverting industries.

Capable of hauling the heaviest freights, over mountain grades, at sustained high speeds, these giant steam locomotives meet the highest standards of motive power efficiency.

LIMA LOCOMOTIVE WORKS INCORPORATED, LIMA, OHIO

electrical workers and carmen were also involved in the election, but these groups voted to retain the brotherhood as their representative.

Bangor & Aroostook electrical workers, carmen, power house employees and railway shop laborers, previously represented by a local committee, have chosen unions operating through the Railway Employees Department of the American Federation of Labor.

Capt. C. L. Combes Returns to R. M. E. Editorial Staff

CAPT. C. L. COMBES, until August 1, 1941, associate editor of the *Railway Mechanical Engineer*, when as a reserve field artillery officer he was called for duty, was returned to inactive status on October 15, 1945, and has again taken up his duties as associate editor. Captain Combes' first military assignment was with the 52nd Coast Artillery (Railway) as a battery officer. He was assigned to the Coast Artillery School as an instructor in November, 1941, handling railway artillery problems. Upon completion of his duties at the Coast Artillery School in August, 1943, he became executive officer for the northern half of the harbor defenses of Los Angeles, Calif., until April, 1944. He was then transferred to the Ordnance Department and became chief of the Editorial Branch, Research and Development Service, Ordnance Department, where he remained until his return to civilian life.

Capt. C. L. Combes

Supply Trade Notes

SAFETY CAR HEATING & LIGHTING CO.—*E. K. Goldschmidt* has been released from active duty as a lieutenant commander in the Naval Reserve and has returned to the Safety Car Heating & Lighting Co. as representative in the Chicago office. Mr. Goldschmidt became associated with the Safety Company in 1933. In 1942 he enlisted and was assigned to duty with the industry cooperation division of the Navy in Washington, D. C., and Chicago.

R. L. Hillpot

R. L. Hillpot has been appointed manager of the Southwestern district of the Safety Car Heating & Lighting Co. with headquarters in Philadelphia, Pa. Mr. Hillpot has been associated with the company since 1915, excepting for a short period of service in the maintenance of way department of the Pennsylvania, and in the Navy during World War I. From 1939 until assuming his present duties, he served as representative in the southeastern district.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—UNION SWITCH & SIGNAL COMPANY.—*Albert Nathaniel Williams*, of New York, president of the Western Union Telegraph Company, has been elected vice-chairman of the boards of directors of the Westinghouse Air Brake Company and the Union Switch & Signal Company. Mr. Williams, who has been a member of the boards of both companies since last February, will assume his new post as vice-chairman on January 1. *Herbert A. May*, assistant to the president of the Westinghouse Air Brake Company and vice-president of the Union Switch & Signal Company, has been elected a member of the board of directors of both companies.

◆

LINCOLN ELECTRIC COMPANY.—*H. F. Kneen* has been appointed vice-president in charge of manufacturing, and *G. G. Landis*, vice-president in charge of engineering for The Lincoln Electric Company, Cleveland, Ohio.

Mr. Landis is a veteran of over 20 years with Lincoln Electric. He received his electrical engineering education at Ohio State University, receiving a Bachelor of Science degree in 1922. After two years with several large electrical companies, he resigned to enter the laboratories of Lincoln Electric in 1924. He became chief engineer in 1930. Mr. Landis is a director of the company and has complete charge of the design and production engineering on welding equipment manufactured by the company. He is a member of the American Welding Society.

◆

KROPP FORGE COMPANY.—*James E. Sweeney*, works manager, has been appointed vice-president and general sales manager of the Kropp Company.

◆

ELWELL-PARKER ELECTRIC COMPANY.—*F. J. Avery*, general sales representative with headquarters in Chicago for the Elwell-Parker Electric Company, Cleveland, Ohio, has been appointed in charge of sales to railroad companies in the Chicago-midwest district. Mr. Avery has been associated with Elwell-Parker since 1936. Previously he was a consulting engineer.

REYNOLDS METALS COMPANY.—*Albert H. Charlton* has been appointed sales manager of the aluminum division of the Reynolds Metals Company, with headquarters in Louisville, Ky. Mr. Charlton had been eastern sales manager for the aluminum division in New York.

◆

ALLIS-CHALMERS MANUFACTURING COMPANY.—*Dr. J. T. Rettaliata*, who recently was appointed director of the mechanical engineering department at the Illinois Institute of Technology, will continue his association with the Allis-Chalmers Manufacturing Company as consultant on gas turbine development and similar problems.

◆

GRAYBAR ELECTRIC COMPANY.—*E. J. O'Donnell*, manager of the railroad department, has been appointed manager of transportation sales for the Graybar Electric Company. In his new assignment Mr. O'Donnell will report directly to general headquarters in New York although he will be located in Chicago, where he has been employed since joining the company in 1910.

E. J. O'Donnell

FRANKLIN
CAR CONNECTIONS
have these 4 Vital Features

1. Low Frictional Resistance to Joint Movements
2. Minimum Leakage
3. Low Maintenance Cost
4. Dependability of Performance

Franklin sleeve-type design provides ease of movement and tight connections, so that steam pressure drop is extremely low.

An additional valuable feature is the ease with which the low-cost gaskets can be replaced.

These factors result in a steam conduit which can be maintained at minimum expense.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

ALLEGHENY LUDLUM STEEL CORPORATION.—The Allegheny Ludlum Steel Corporation has placed first on its peacetime expansion program the immediate erection of a $2,000,000 research laboratory and experimental center at its headquarters plant, Brackenridge, Pa. With the new facilities, an enlarged and intensified program of fundamental and applied research will be brought to bear on the highly specialized stainless, magnetic, valve, tool, and other complex steels produced by the company. In addition, new and improved fabricating techniques will be developed, to bring increased aid to the manufacturers of appliances and equipment used in American homes, businesses and industries.

◆

ELECTRONIC LABORATORIES, INC.—Electronic Laboratories, Inc., Indianapolis, Ind., has announced that the following new jobbers have taken on sales distribution for the company's auto radio vibrator replacement lines: Radio Wire Television, Inc., Boston, Mass.; Radio Products Sales, Denver, Colo.; Radio Electric Products, Buffalo, N. Y.; Radio Products Sales Los Angeles, Calif.; Scott Radio Supply, Long Beach, Calif.; Hatry and Young, Hartford, Conn.; the Roehr Distributing Company, St. Louis, Mo.; the R. and R. Part & Supply Co., Inc., Lubbock, Texas; and the Central Missouri Distributing Company, Jefferson City, Mo.

◆

AMERICAN LOCOMOTIVE COMPANY.—*Carl J. Dinic* has been appointed executive assistant to the president of the American

Carl J. Dinic

Locomotive Company. Mr. Dinic became associated with the company in July, 1943, as assistant to the president. Prior to that he was with the United States Steel Corporation, Pittsburgh, Pa., and with Eastern Gas & Fuel Associates, Boston, Mass.

◆

GENERAL STEEL CASTINGS CORPORATION.—*Comm. B. W. Taylor* has been appointed assistant chief mechanical engineer of the General Steel Castings Corporation. Commander Taylor recently was released from active duty by the Navy Department. He is a graduate of Pennsylvania University with a degree in mechanical engineering (1917). He served in the United States Army and in the Navy in the first world war. He was instructor in mechanical engineering at Pennsylvania University from 1920 to 1923. In the latter year he joined the SKF Industries, Inc. From 1933 to

Comm. B. W. Taylor

1943 he was railway engineer of that company, in charge of engineering and service in all matters pertaining to railway applications. He returned to naval service in August, 1943, and served for approximately two years with the bureau of aeronautics.

◆

CUTLER-HAMMER, INC.—*F. A. Wright* has been appointed assistant general sales manager of Cutler-Hammer, Inc., Milwaukee, Wis. Mr. Wright has been associated with Cutler-Hammer since 1927.

◆

DEARBORN CHEMICAL COMPANY.—*F. B. Horstmann,* technical director of the railroad department of the Dearborn Chemical Company, has retired after 40 years of service. Mr. Horstmann entered service with the company in 1905 as a chemist, and in 1917 he was appointed chief chemist. In March, 1922, he was assigned to the industrial department, and in June, 1926, became chemical engineer of the railroad department. In 1941 he was appointed technical director.

◆

CUMMINS ENGINE COMPANY. — The Cummins Engine Company has reorganized its sales department, creating two new sales divisions. Under the new plan, sales activities will be divided into two major fields —direct sales through dealers, and sales to manufacturers who power their equipment with Cummins Diesels. *Paris E. Letsinger* is the company's vice-president in charge of distribution. *Norman E. Palmer,* for the past three years Washington, D. C., representative for Cummins, has been appointed general sales manager to work directly with Mr. Letsinger. *J. D. Allen,* assistant sales manager, has been appointed sales manager of dealer organizations, and *Fred W. Sparks,* manager of the Cleveland, Ohio, regional office, has been appointed sales manager of manufacturing accounts.

◆

CINCINNATI LATHE & TOOL CO.—Incorporation papers have been filed for a new concern, the Cincinnati Lathe & Tool Co., which has acquired the land, buildings, machinery, designs, inventory, unfilled orders, and trade name of the Cincinnati Lathe & Tool Company, Oakley, Ohio. The new company is a subsidiary of the Cincinnati Milling Machine Company, but will be entirely independent in operation. The Cincinnati Lathe & Tool Company has discontinued manufacturing operations because of the retirement of its president, *W. C. Heindel.* The new officers are *Millard Romaine,* president, and *E. W. Mueller,* secretary-treasurer.

◆

ELECTRONIC LABORATORIES, INC.—*B. G. Twyman & Associates* have been appointed distributors for the Electronic Laboratories, Inc., of Indianapolis, Ind., in Illinois and eastern Missouri, outside of the metropolitan districts of Chicago and St. Louis, Mo. The territory of *A. E. Rodman,* west coast representative, has been increased to include Nevada and Oregon.

◆

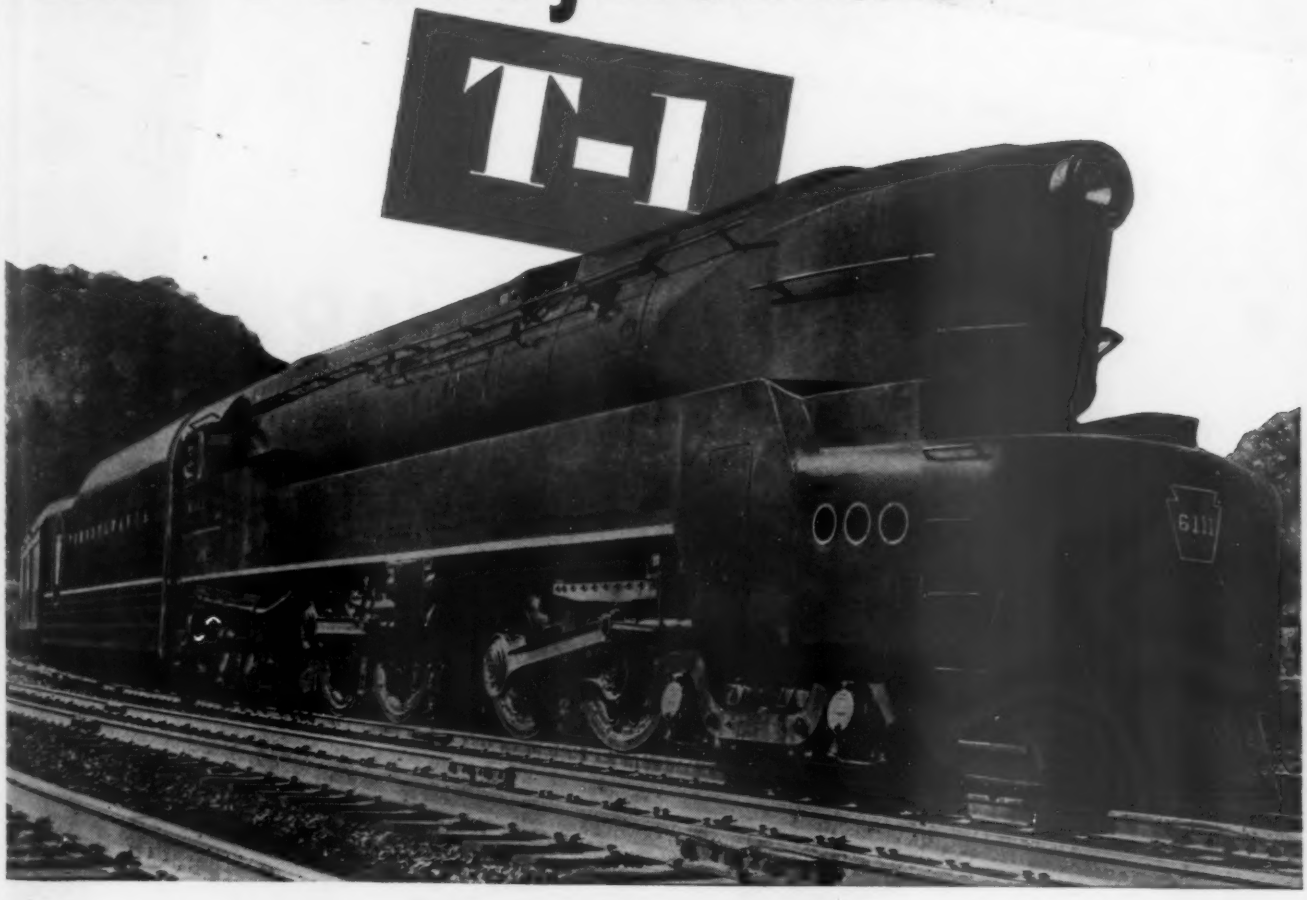
BALDWIN LOCOMOTIVE WORKS. — The Southwark division of the Baldwin Locomotive Works has placed field sales engineers in five of the company's branch offices in order to give better service to users of the SR-4 strain gage. The men and their offices are *Richard Hannon,* Boston, Mass.; *Joseph Farley,* Chicago; *Robert Cleeland,* New York; *Glenn Rowell,* Philadelphia, Pa.; and *Stanley Zansitis,* Detroit, Mich.

Robert G. Allen has been appointed general sales manager of the Baldwin Locomotive Works. Mr. Allen was educated at Harvard University. He joined the Walworth Company in 1925 and was division sales manager from 1929 until 1936. He then served two terms (1936-1940) as a representative of Pennsylvania in the United States Congress. He was elected president of the Duff-Norton Manufacturing Company in 1940. In July, 1942, he was granted a leave of absence to accept a commission as a major in the Army. He

Robert G. Allen

served as chief of the tank branch and later as executive officer of the Philadelphia, Pa., ordnance district. He was promoted to the rank of lieutenant colonel in February, 1943, and a few months later transferred to field service and overseas where he served as a battalion commander and a group commander. He was returned to the United States in November, 1944, and placed on the inactive list January, 1945. He joined the Baldwin organization as general manager of the Baldwin Southwark division in March 1945.

the Pennsylvania's



is equipped with SECURITY CIRCULATORS

That Security Circulators are recognized as an important contribution to modern locomotive design is shown by their use in The Pennsylvania Railroad's famous T-1 class locomotives, each of which has five circulators in the firebox.

AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

IT'S A GREAT NEW DAY FOR RAILROADING

ESSENTIAL IN WAR

ESSENTIAL IN PEACE

GENERAL MOTORS
LOCOMOTIVES

Someday the dramatic role that General Motors Diesel locomotives played during the war may be told. The speed with which vital war material and supplies were spirited across the land to Pacific coast ports will be one for the book.

Equally essential in peace, they can step up the passenger, freight and switcher operations of an entire railroad — with faster, more dependable schedules; proved efficiencies and economies; and a broadening of the railroad's good will among passengers and shippers.

That's why there was a step-up in Electro-Motive's production program during the war — and why there are no factory reconversion problems at La Grange.

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION • LA GRANGE, ILL.

FAIRBANKS, MORSE & CO.—*Charles H. Morse, III,* president of the Inland Utilities Company (a subsidiary of Fairbanks, Morse & Co.), has been elected vice-president of Fairbanks, Morse. Mr. Morse will continue as president of the subsidiary. In his new position he will be in charge of research, patents, and the western pump division on the parent company.

Frank E. Ross, Jr., heretofore in charge of the Diesel locomotive section of the U. S. Railroad Mission in Mexico, has been appointed assistant to *John W. Barriger, III,* manager of the Diesel locomotive department of Fairbanks, Morse & Co., with

Frank E. Ross, Jr.

office at 600 S. Michigan Avenue, Chicago. Mr. Ross was born at St. Louis, Mo., on July 25, 1916, and was educated in the public schools of St. Louis and in night extension courses at Washington University in that city. He entered the service of the Terminal Railroad Association of St. Louis as an electrician apprentice in 1936 and advanced through the maintenance of equipment and transportation departments to foreman of the company's Diesel locomotive repair shop. He left the T. R. R. A. in August, 1944, to go to Mexico with the railway mission, which was the connection he relinquished to join Fairbanks, Morse.

◆

IRON & STEEL PRODUCTS, INC.—*James C. Magee* has been appointed manager of the machinery department of Iron & Steel Products, Inc., with headquarters at Chicago. *Charles A. Marshall,* manufacturers' representative in the southern West Virginia territory, has been appointed sales engineer, with headquarters also at Chicago.

◆

GENERAL MOTORS CORPORATION.—*Louis F. Stuebe* has rejoined the Chicago sales enginering staff of the Hyatt Bearings division of the General Motors Corporation. Mr. Stuebe, who will specialize in Hyatt railroad applications, has been associated with Hyatt as a sales engineer since June, 1925. He was recently released as a Colonel from the Army.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*James B. Rosser,* administrative assistant to the president of the Pullman-Standard Car Manufacturing Company, at Chicago, has been elected a vice-president in charge of sales of railroad equipment, with headquarters at New York. *Fred W. Alger* and *John C. Bell,* sales agents at Chicago, have been appointed assistant vice-presidents with headquarters at Chicago.

◆

GENERAL ELECTRIC COMPANY.—*L. D. T. Berg,* for the past five years a sales engineer in General Electric Company's electric welding division, Schenectady, N. Y., has been appointed welding specialist, Atlantic district, with headquarters in Philadelphia, Pa.

◆

ELWELL-PARKER ELECTRIC COMPANY.—*J. P. Lyons* has retired as Ohio district sales representative for the *Elwell-Parker Electric Company,* Cleveland, Ohio

◆

COPPERWELD STEEL COMPANY.—*Harry C. Dever* has returned to the Glassport, Pa., division of the Copperweld Steel Company and has been placed in charge of the Atlanta, Ga., office to cover the states of Georgia, Florida, South Carolina and North Carolina. Mr. Dever had been on a three years' leave of absence with the armed forces. Prior to the war, he covered the southeastern part of the United States for Copperweld.

◆

AIREON MANUFACTURING CORPORATION.—*Kenneth D. Halleck,* Washington sales representative for the past two years for the Aireon Manufacturing Corporation and before that, representative for the company on its army contracts with the Signal Corps procurement district in Philadelphia, Pa., and Dayton, Ohio, has been elected a director of the company. Mr. Halleck will transfer to the company's headquarters in Kansas City, Mo., as administrative assistant to the executive vice-president.

◆

EVANS PRODUCTS COMPANY.—*Edward S. Evans, Jr.,* chief executive of the Evans Products Company, Detroit, Mich., has been elected president of that firm, succeeding his father, E. S. Evans, whose death on September 6 was reported in the October issue. *Prewitt Semmes,* secretary and general

Edward S. Evans, Jr.

counsel, has been elected a member of the board of directors. Mr. Evans was born at Richmond, Va., and is a graduate of the University of Michigan and the University of Lausanne, Switzerland. He went to Detroit with his father in 1915 and during the ensuing years he became familiar with every phase of the business. After holding various positions with the company he was elected vice-president and also became a member of the board of directors. In 1935 he was elected to the position of chief executive.

◆

AMERICAN SMELTING & REFINING COMPANY.—*Aubrey M. Callis* has been appointed sales manager of the Whiting, Ind., and Detroit, Mich., plants of the Federated Metals division of the American Smelting & Refining Co. Mr. Callis, formerly assistant general manager of the Pacific Coast department with headquarters at Los Angeles, Calif., has been associated with Federated since 1928 in sales and plant executive capacities.

◆

UNION SWITCH & SIGNAL CO.—*Charles M. Wheeler,* assistant district manager, has been appointed district manager of the Union Switch & Signal Co. with headquarters in New York. Mr. Wheeler is a graduate of the Pennsylvania State College with a bachelor of science degree (1911) and an electrical engineering degree (1913). He began his career as a

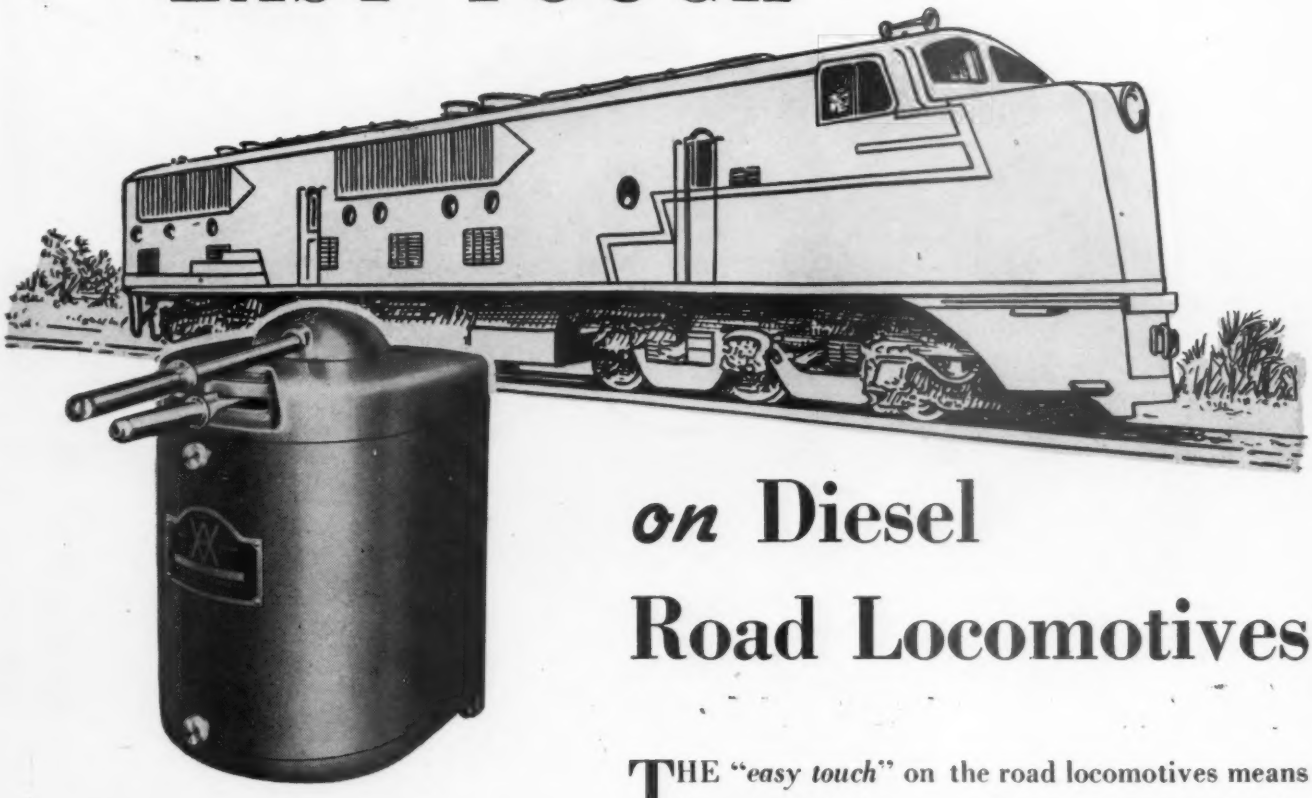
C. M. Wheeler

signal apprentice on the Pennsylvania in July, 1911, and was advanced through different positions until his appointment as assistant supervisor of signals in March, 1916. From March, 1918 to March, 1921 he held the positions of assistant division operator and division operator at Pittsburgh, Pa., after which he served on the E. & A., eastern and Pittsburgh divisions, as supervisor telegraph and signals. He left the Pennsylvania in September, 1927, to become sales engineer for the Union Switch & Signal Co., and in October, 1940, was transferred to New York as assistant district manager.

Obituary

MORTIMER R. KEMPTON, engineer of freight cars of the Pullman-Standard Car Manufacturing Company, died on November 8 while on a vacation at Martinsville, Ind. Mr. Kempton was born in 1887. In 1910 he went with the car-building firm of Haskell & Barker, Michigan City, Ind., and in 1922, when that company was merged with Pullman-Standard, he joined the latter organization.

How to Put the
"EASY TOUCH"

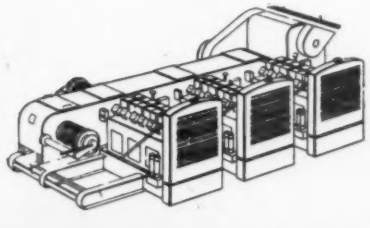


on Diesel Road Locomotives

THE "*easy touch*" on the road locomotives means finer control of power and smoother starting by means of the pneumatic throttle. With the engine idling, setting up of electrical circuits and regulation of engine speed are governed by the control handle. In the starting zone, engine speed is held constant and the field resistance cut out gradually until full power intensity is applied.

As the handle is advanced further, the pneumatic throttle cuts in and increases engine speed progressively. Operation is interlocked with the reverser handle so that the reverser cannot be moved to change direction unless the control handle is moved to "off" position. Smooth starting, precise engine control and direction interlocking are characteristic of the pneumatic throttle — single handle control.

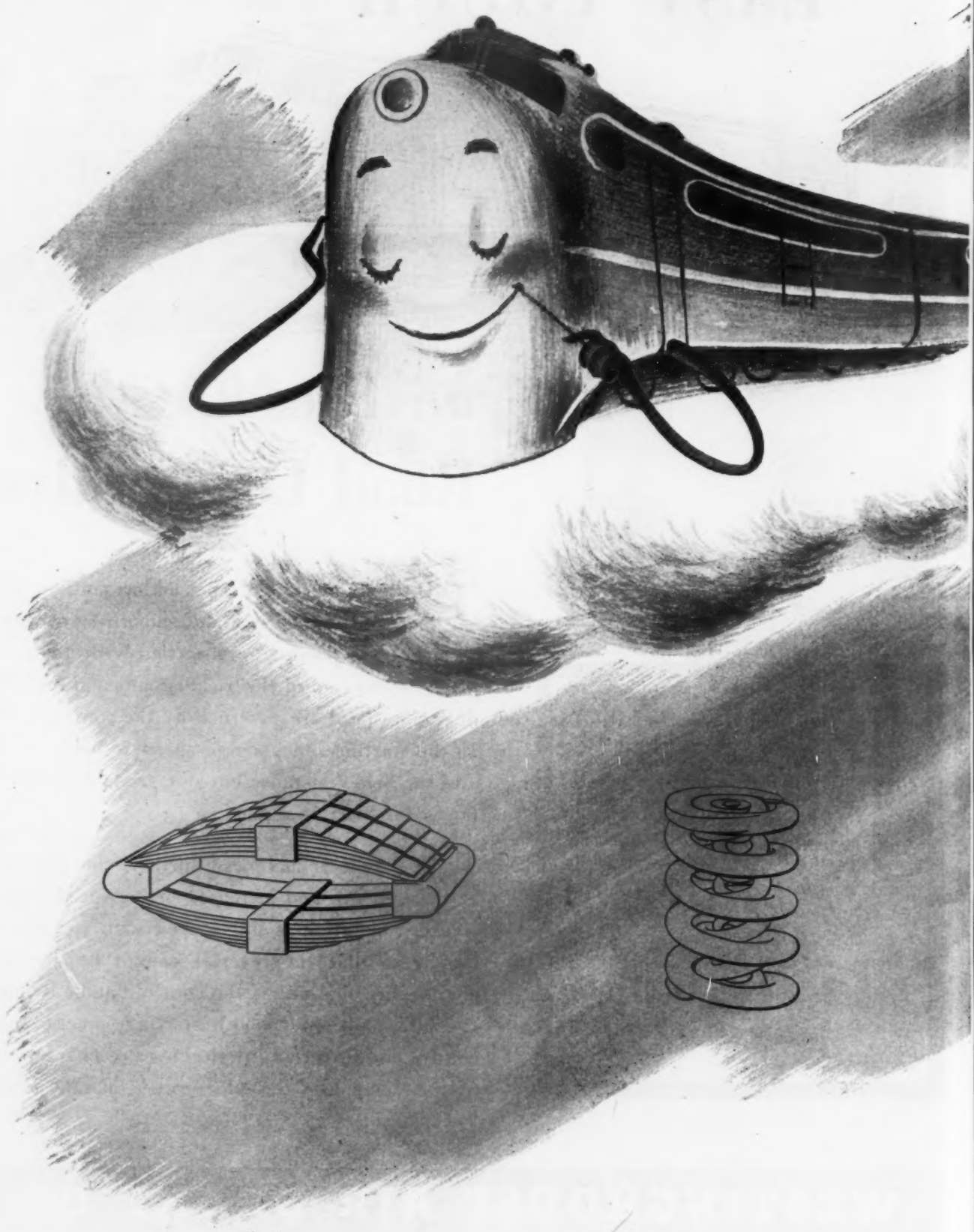
The pneumatic throttle, as used on all classes of steam and Diesel locomotives, has demonstrated a wide utility for stationary and marine Diesels. An interesting application is on oil rigs where three Diesels work together on hoisting operations. The pneumatic throttle synchronizes engine output by maintaining balanced fuel supply to all three engines.

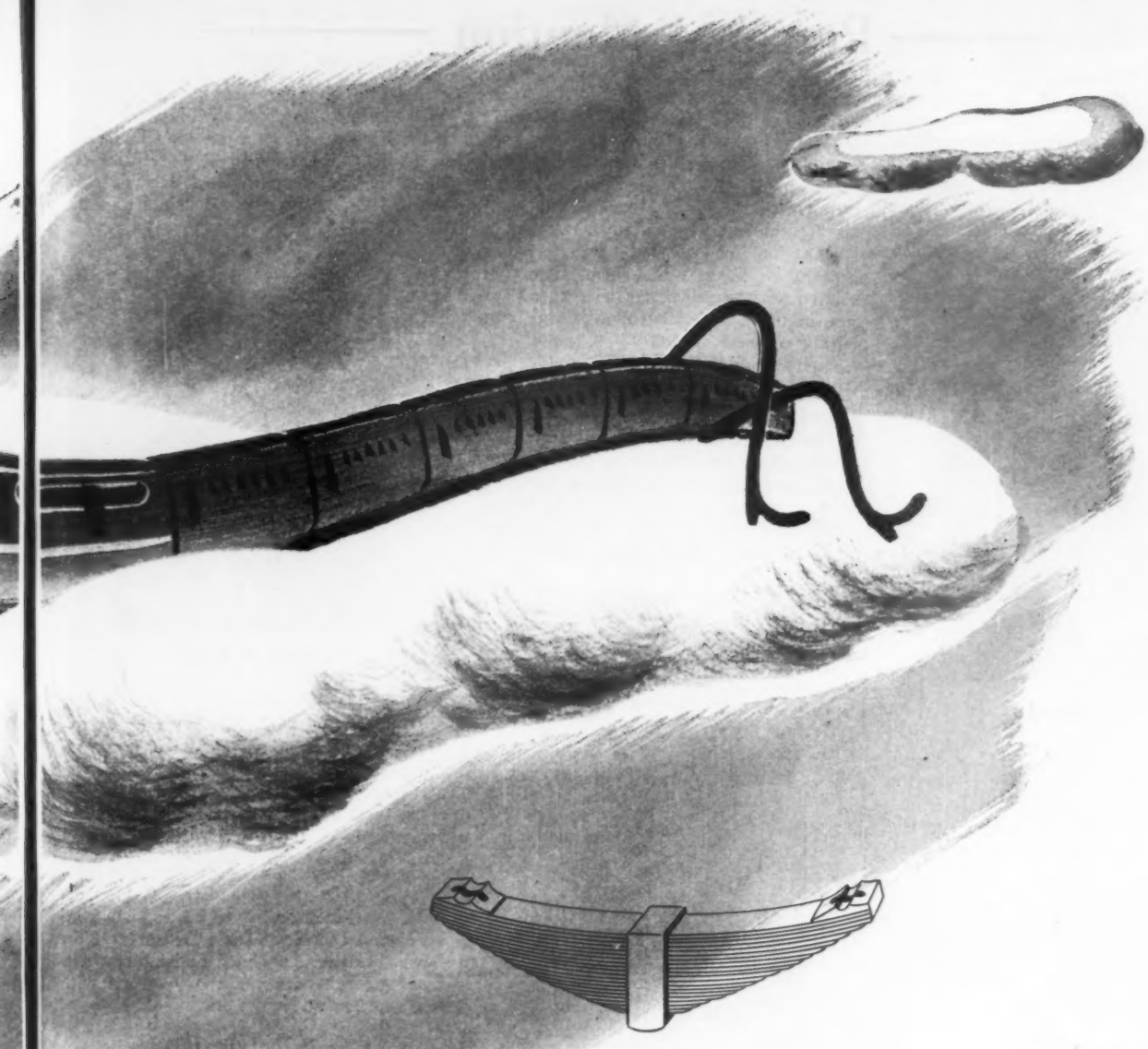


WESTINGHOUSE AIR BRAKE CO.

WILMERDING, PENNSYLVANIA

Railroad Popularity Rides On Springs





RIDING comfort, or its lack, can help or damage any railroad.

The riding qualities resulting from correct design and fabrication of RAILWAY STEEL SPRINGS on a large number of America's leading railroads are helping promote passenger and freight traffic, friendly public relations, longer equipment life, greater factor of safety, and lower maintenance expense.

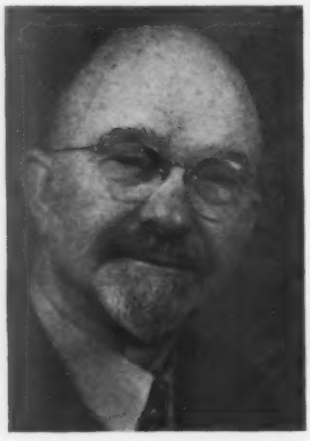
RAILWAY STEEL SPRINGS of standard or special design can be supplied for any railroad purpose and problem to your complete satisfaction.

American Locomotive

Personal Mention

General

FRANK E. RUSSELL, whose retirement as chief mechanical engineer of the Southern Pacific was reported in the November issue of the *Railway Mechanical Engineer,* was born at Davis, Calif., on September 25, 1875. He became a laborer in the employ



F. E. Russell

of the Southern Pacific at Sacramento, Calif., in September, 1899. He served for a short time in the office of the stores department and in 1900 was assigned to the office of the mechanical engineer, with headquarters at Sacramento. In 1903 Mr. Russell was promoted to the position of lead draftsman and three years later became chief locomotive draftsman, also at Sacramento. In 1917 he was appointed assistant mechanical engineer, with headquarters at San Francisco, Calif.; in 1924 mechanical engineer, and on January 1, 1944, chief mechanical engineer.

JOHN MCMULLEN has retired as consulting engineer of the Erie at Cleveland, Ohio. Mr. McMullen was born in Balley Keel, County Down, Ireland, on December 20, 1871, and came to the United States in 1886. He entered railway service in 1888

John McMullen

as an apprentice in the Buffalo car shop of the Erie. He became a carpenter and cabinetmaker there in 1892 and a gang foreman in 1896. From 1904 to 1906 Mr. McMullen served as passenger-car foreman, then as shop superintendent in North Paterson, N. J. He served as general piecework inspector at Meadville, Pa., until his appointment as shop superintendent at Kent, Ohio, in 1907. He transferred to Buffalo, N. Y., in 1912, where he was appointed superintendent, car department, system, in 1913. Mr. McMullen became consulting engineer in 1941.

J. H. WHIPPLE, JR., who has been appointed superintendent of Diesel equipment of the Denver & Rio Grande Western as announced in the October issue, was born on November 3, 1912, at Topeka, Kan. He is a graduate of Topeka High School (1930) and of the General Motors Institute of Technology, Flint, Mich. (1934) Mr.

J. H. Whipple, Jr.

Whipple began his career with the D. & R. G. W. as system shop engineer in March, 1942. In July, 1942, Mr. Whipple became assistant Diesel supervisor; on August 1, 1943, Diesel supervisor, and on August 1, 1945, superintendent Diesel equipment, with headquarters at Denver, Colo.

THOMAS H. EVANS, whose appointment as chief mechanical officer of the Missouri-Kansas-Texas with headquarters at Parsons, Kan., was reported in the November issue, was born at Whitewright, Tex., on October 15, 1899. He entered the employ of the M-K-T on March 15, 1916, as a machinist apprentice at Denison, Tex., completing his apprenticeship on April 5, 1920. After a brief period of service as a machinist with the St. Louis-San Francisco at Oklahoma City, Okla., he returned to the M-K-T as a machinist at Denison. In April, 1921, he became a machinist in the

Thomas H. Evans

employ of the Louisiana & Northwestern at Homer, La. He again returned to the M-K-T as a machinist at Waco, Tex., on August 25, 1923, and subsequently served as gang foreman and general foreman. Mr. Evans became shop superintendent on February 1, 1940, and served in that position until his appointment as chief mechanical officer.

M. W. MCMAHON, special appliance inspector of the New York Central at New York, has been appointed assistant to general superintendent motive power, with headquarters at New York.

Electrical

J. M. TRISSAL has been appointed superintendent communication and electrical engineer of the Illinois Central, with headquarters at Chicago. Mr. Trissal was born on December 30, 1903, in Chicago. He

J. M. Trissal

attended high school in Chicago, and is a graduate of the University of Illinois with a degree of Bachelor of Science (1925). He received the degree of Elec-

In Military Service

BRONZE STAR MEDAL

Maj. Albert D. Hartzler, of Cincinnati, Ohio, formerly mechanical supervisor of the Cincinnati Union Terminal, recently was awarded the Bronze Star Medal at Marseilles, France, "for outstanding service as mechanical engineer and as head of Requirements Section, Headquarters, Second Military Railway Service, from May 1, 1944, to March 20, 1945."

trical Engineer in 1940. He entered railroad service as a draftsman in the signal department of the Illinois Central during the summer of 1924. In June, 1925, he returned to the Illinois Central signal repartment, and in 1926 was transferred to the electrical department of the Chicago Terminal Improvement and appointed junior engineer, later serving as assistant engineer. Following the completion of the electrification program in June, 1930, Mr. Trissal was appointed assistant electrical engineer fixed property, reporting to W. M. Vandersluis, general superintendent of telegraph and signals. In November, 1931, Mr. Trissal became electrical engineer; fixed property.

A. D. MACPHERSON, electrical engineer, department of research and development, of the Canadian National at Montreal, Que., has been appointed controller of test materials and research there.

Master Mechanics and Road Foremen

ROBERT GUY FIELD, who has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific at Ludlow, Ky., as announced in the October issue, was born on August 4, 1897, at Macon, Ga. He attended high school and during 1914-15, through correspondence, took the Central of Georgia Railway Educational Bureau Engineering Course. On February 10, 1911, he became a toolroom boy in the employ of the Georgia Southern & Florida at Macon, Ga., and from February 11, 1913, until December 10, 1917, he was a machinist apprentice. He then entered the service of the Southern as a machinist at Birmingham, Ala. On April 16, 1923, he became enginehouse foreman at Greensboro, N. C. He returned to Birmingham on February 21, 1925, as assistant enginehouse foreman. From February 2, 1926, until April 2, of the same year he served as a machinist and from the latter date until July 17, 1926, was a machinist supervisor. He became night enginehouse foreman on July 17,

R. G. Field

1926; assistant foreman enginehouse on January 26, 1927; and day enginehouse foreman on May 2, 1932. On June 1, 1934, Mr. Field was transferred to the Somerset, Ky., shops of the Cincinnati, New Orleans & Texas Pacific as day enginehouse foreman. He returned to the Southern on February 20, 1937, as enginehouse foreman at Princeton, Ind.; on December 13, 1939, became enginehouse foreman of the Cincinnati, New Orleans & Texas Pacific at Somerset, and on May 16, 1941, general enginehouse foreman of the Southern at Birmingham. On March 16, 1942, he was transferred to the New Orleans & North Eastern as general foreman at Meridian, Miss., and on January 1, 1945, was appointed assistant master mechanic. He became master mechanic of the C. N. O. & T. P. at Ludlow on September 1, 1945.

ROBERT J. DUNN, district foreman of the Union Pacific at North Platte, Neb., has been appointed master mechanic, with headquarters at Denver, Colo.

JAMES E. GOGERTY, master mechanic of the Union Pacific at North Platte, Neb., has been transferred to the position of master mechanic at Cheyenne, Wyo.

Car Department

ROBERT SCHEY has been appointed superintendent of the car department of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio. The position of general superintendent car department has been abolished.

Shop and Enginehouse

BERNARD COOK, who has been appointed superintendent of shops of the Norfolk & Western at Roanoke, Va., as noted in the October issue, was born on October 20,

Bernard Cook

1886, in Roanoke. He is a graduate in civil engineering of the Virginia Polytechnic Institute (1928). On November 1, 1909, he entered the service of the Norfolk & Western as assistant engineer tests. On August 1, 1925, he was appointed mechanical inspector; on May 16, 1927, general foreman locomotive department, and on September 1, 1945, superintendent of shops at Roanoke.

Obituary

E. A. PARK, superintendent of motive power and equipment of the Peoria & Pekin Union at Peoria, Ill., who had been on leave of absence since October 20, died recently in that city.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

POWER HAMMERS. — McKiernan-Terry Corporation, Park Row Building, New York 7. Bulletin 56, "The Mechanical Blacksmith's Helper," describes in detail the design and construction of the McKiernan-Terry Blacker power hammer, with specifications and sectional drawings.

◆

SILICONES.—Dow Corning Corporation, P. O. Box 592, Midland, Mich. 12-page illustrated pamphlet, "Dow Corning Silicones, New Engineering Materials," descriptive of Dow-Corning silicones—compounds and greases, fluids, varnishes and resins, and Silastic, a silicone rubber.

◆

TRAIN COMMUNICATION EQUIPMENT.—Aireon Manufacturing Corp., Kansas City 15, Kan., "The Time Has Come," a 26-page illustrated booklet in stiff covers, describes the application of inductive and space radio communications systems to railroad service. In a pocket of the back cover is a separate bulletin on the company's inductive type of equipment and a photograph of its railroad radio laboratory which is used in a baggage car.

◆

"GLOSSARY OF MACHINE SHOP TERMS."—Kropp Forge Company, 5301 West Roosevelt Road, Chicago 50. 32-page booklet. Words and terms are defined as used in heavy machine shop practice, with recognition of the fact that other definitions are sometimes employed in various industries for describing identical process or operations.

◆

"FRICTION SAWING." — DoALL Company, Machine Tool Division, 1301 Washington avenue South, Minneapolis 4, Minn. 24-page booklet explains why friction sawing is possible; its advantages, and its limitations. Contains Job Selector chart for use in selecting proper sawing factors in cutting SAE steel, stainless steel, cast steel, and cast iron.

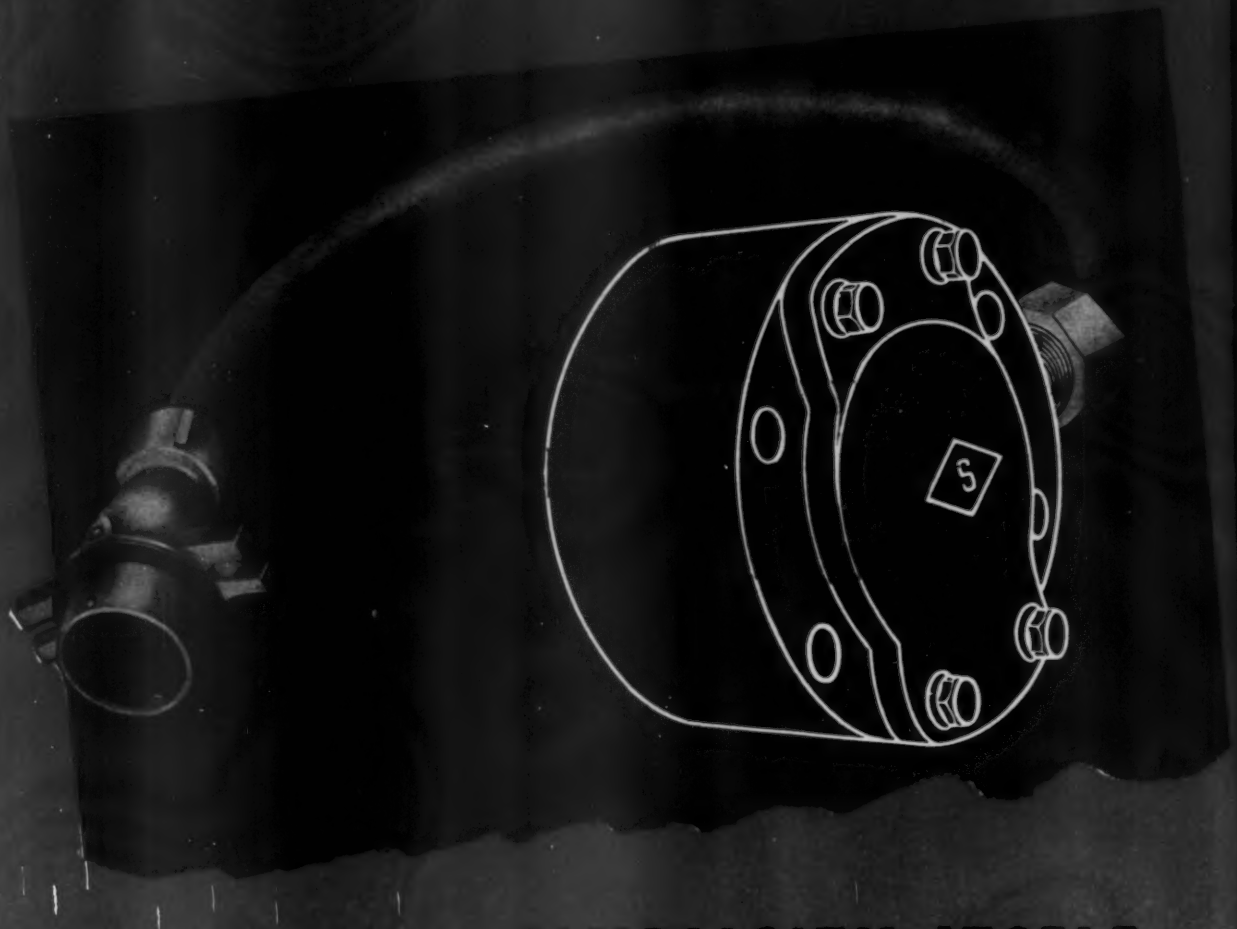
◆

CELLULAR RUBBER.—Sponge Rubber Products Company, Derby Place, Shelton, Conn. Four-page pamphlet, 845-21, describes various forms in which sponge rubber, bonded fibre and other sub-density materials are manufactured. Illustrates molded, die-cut and fabricated shapes of flexible, elastic compressible productions for cushioning, shock absorption, vibration dampening, etc.

◆

ELECTRICAL REPAIR EQUIPMENT.—Ideal Commutator Dresser Company, Sycamore, Ill. "Modern Motor-Generator Maintenance and Repair Equipment for Re-conditioning War Weary Machinery," a 36-page catalog which illustrates and describes a great variety of equipment used in electrical maintenance.

the American Brake Shoe



SIMPLICITY ITSELF
in construction and operation

• The simplicity of the American Brake Shoe Controller, is shown by the above drawing. There is but one moving part — a rugged rotor.

• Testing is simple, too. Operation can be accurately checked when car is standing or moving.

AMERICAN
Brake Shoe
COMPANY

BRAKE SHOE AND CASTINGS DIVISION
230 Park Ave., New York 17, N. Y.

Controller...

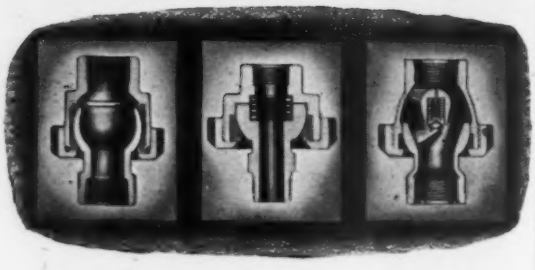
RELIABILITY ITSELF
in prevention of slid flats

• The American Brake Shoe Controller is positive in its detection of wheel slippage . . . instant in its correction . . . unfailing in its restoring of full brake as soon as slippage is eliminated.

• Passenger Traffic and Operating officials welcome the availability of equipment made possible by the use of the American Brake Shoe Controller, proved by years of successful performance on high speed passenger trains.

4139

Quick responsive movement is the natural safeguard against sudden strains and shocks. Barco Flexible Joints are designed to provide compensation for movement always present in fluid-conveyor systems...counteracting destructive vibration, expansion and contraction. Today, as for the past 30 years, engineers and designers throughout industry and transportation look to Barco for solution to their flexible joint problems. Write to Barco Manufacturing Co., Not Inc., 1808 Winnemac Ave., Chicago 40, Illinois.



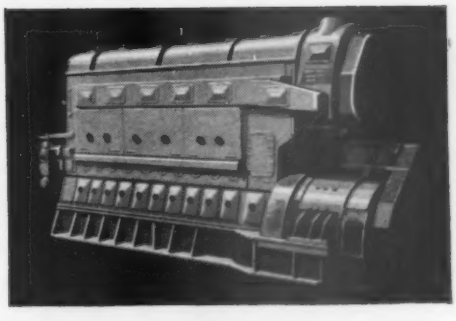
BARCO FLEXIBLE JOINTS

Not just a swivel joint...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

In Canada: The Holden Co., Ltd., Montreal, Canada "MOVE IN EVERY DIRECTION"

TOMORROW'S POWER TODAY!



It's the
Full-Power
Diesel Locomotive
by

FAIRBANKS-MORSE

A NAME WORTH REMEMBERING

FREE ON REQUEST

There are now three of these helpful lists of books on Motive Power, Rolling Stock, and Engineering and Maintenance, which are free on request. They are uniform in size, 3½ x 8 inches, and each describes from 60 to 80 titles of all publishers. Send for your copies today.

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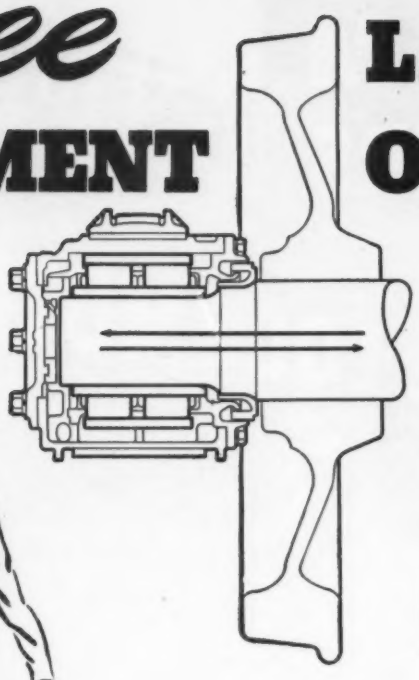
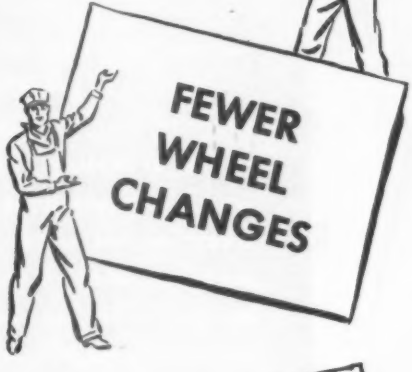
This Stands for Honorable Service to Our Country

Respect its wearer, whoever he or she may be, for it represents an honorable discharge from the armed forces of the United States . . . *for a job well done.*

Free LATERAL MOVEMENT OF AXLES





"Free lateral" is not a common trade name—it is distinctly applied to Hyatt Journal Boxes.

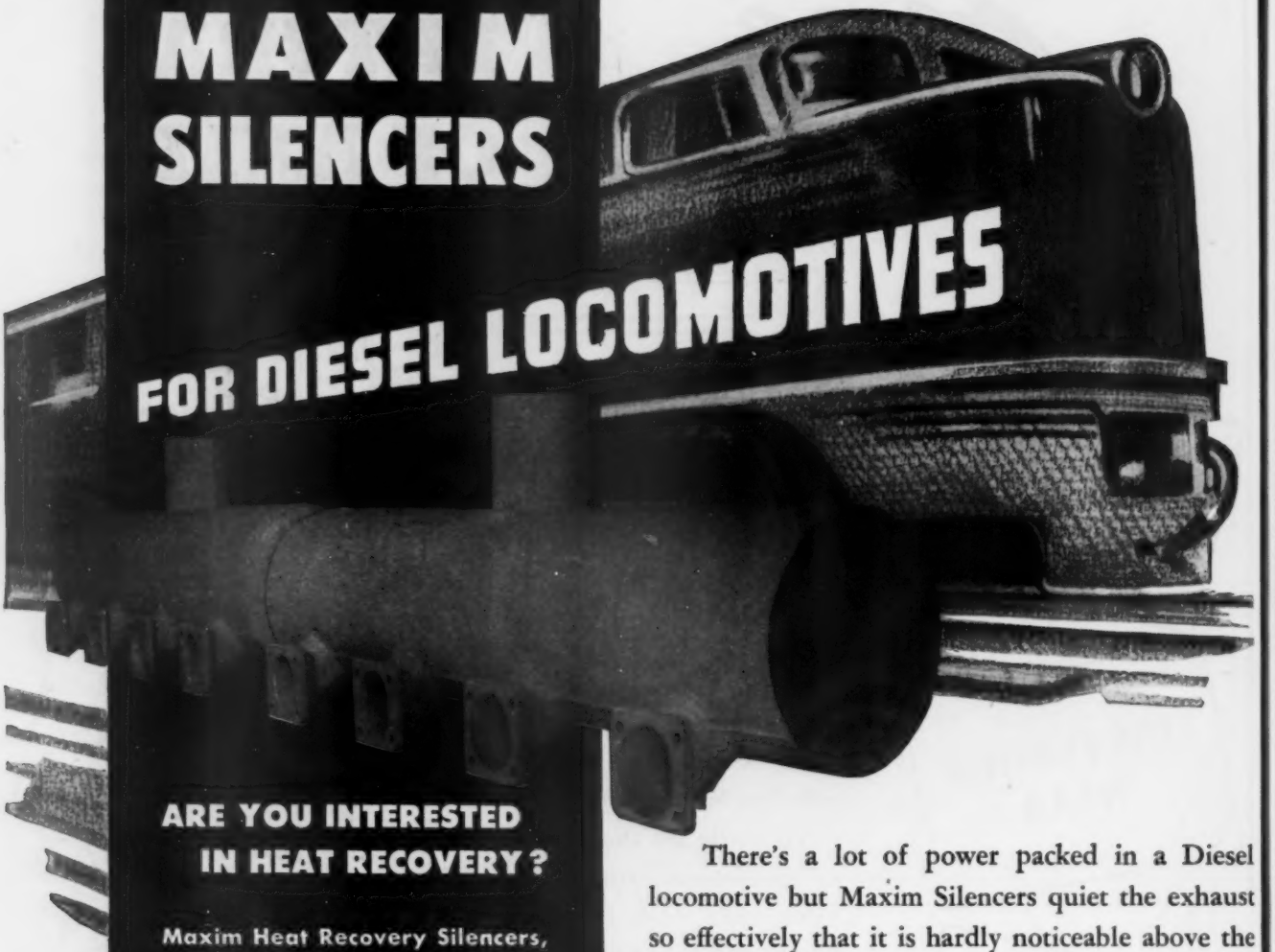
To really get the true meaning of "free lateral," you have to equip your cars with Hyatt Journal Boxes and experience their many advantages.

The operators of the many railroads running Hyatt-equipped cars and Diesel locomotives have proved to their profit and satisfaction the full meaning of "free lateral movement of axles."

A new booklet—just off the press—gives the experiences of Southeastern roads using Hyatt-equipped journal boxes. Write for your copy. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARING RAILROAD JOURNAL BOXES

MAXIM SILENCERS FOR DIESEL LOCOMOTIVES



ARE YOU INTERESTED IN HEAT RECOVERY?

Maxim Heat Recovery Silencers, in addition to providing effective silencing and, where necessary, spark arresting, also recover waste exhaust heat to produce steam or hot water for heating purposes. Maxim engineers will be glad to discuss possible applications to your problems. Send for Heat Recovery Bulletin WH 101.

There's a lot of power packed in a Diesel locomotive but Maxim Silencers quiet the exhaust so effectively that it is hardly noticeable above the low rumble of wheels, clicking rail joints, etc. Good public relations demand this type of silencing when yards or right-of-way lie in or near business or residential sections.

The illustration shows Maxim exhaust manifold silencers which replace the conventional exhaust manifold and thus provide considerable saving of space. Standard Maxim exhaust silencers are also used in Diesel locomotives, and, in fire hazard areas such as refineries, ordnance plants, lumbering operations, etc., are equipped with the Maxim Spark Arrestor which traps 100% of the exhaust sparks.

THE MAXIM SILENCER COMPANY • 65 HOMESTEAD AVE., HARTFORD, CONN.

ARMY E NAVY

MAXIM

American Hammered

PISTON RINGS

in every size . . . of every type

for every purpose

AVAILABLE NOW!

You can get all the American Hammered Piston Rings you need, in any size . . . of any type . . . for any purpose . . . just as promptly as you did in pre-war years.

You'll find that these new rings reflect a quarter-century of peacetime skill and experience and *another* quarter-century of experience and progress that was crowded, by the needs of the nation, into five years on the calendar.

Wartime accomplishments include the production or perfection of such revolutionary new developments as the wear-banishing "PORUS-KROME" *treatment, and the life-extending, performance-boosting high-tensile alloys.

Let us demonstrate that now as in the past, American Hammered Piston Rings plus American Hammered engineering service give the answer to every ring need.

KOPPERS COMPANY, INC.

American Hammered Piston Ring Division

Baltimore 3, Maryland

* VAN DER HORST PROCESS

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

NO HARD CARBON

all rings free after 157,076 miles!

Rock Island "Rocket" Test Shows Efficiency and Economy of RPM DELO Oil

There were no oil changes—RPM DELO Diesel Engine Lubricating Oil was added only as required for make-up. At the end of the test all rings were free, ports unclogged . . . because the inhibiting, detergent and peptizing properties of RPM DELO Oil prevent formation of hard or abrasive carbon. Wear on engine parts, liners, rings and pistons was reduced, entire engine assembly was definitely cleaner, lubricating costs were markedly reduced.

RPM DELO Oil will prove superior in your service, too. Get full information from your RPM DELO Oil Distributor, or write for details.

RPM DELO
DIESEL ENGINE LUBRICATING OIL

Write on your letterhead for free booklet on RPM DELO Oil to Standard of California, Dept. R-1, 225 Bush St., San Francisco 20, Calif., or California Commercial Co., 30 Rockefeller Plaza, New York 20, N. Y.

STANDARD OF CALIFORNIA

RPM DELO Oil has world-wide distribution under the names: RPM DELO, Caltex RPM DELO, Kyso RPM DELO, Signal RPM DELO, Imperial RPM DELO (CONCENTRATE)

CHRISTMAS *and* TRAINS GO TOGETHER!

PHOTO COURTESY THE LIONEL CORPORATION

Railroading is always close to the hearts of American boys and men. In the glow of Christmas, when families gather for fun and feast, the toy railroad is a center of interest for young and old. For railroads are an exciting, romantic part of our civilization. Their history is the history of the nation. Their work keeps millions on farms, in factories, offices . . . everywhere . . . busy.

Let's encourage model railroaders. Their pastime interest may well lead to a lifetime loyalty in railroad work.

HY-PRESSURE
HY-CROME
"Edgemark of Quality"

EATON
EATON MANUFACTURING COMPANY

MASSILLON, OHIO *Reliance Division*

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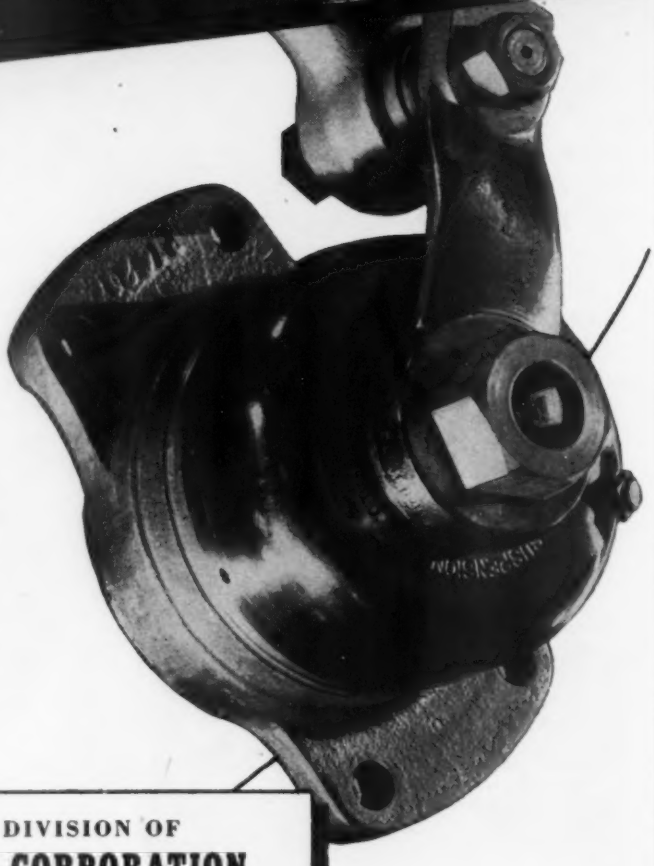
HYDRAULIC COMFORT For BURLINGTON'S NEW VISTA DOME CAR

● Luxurious riding qualities will be a Houdaille* contribution to Burlington's thrilling new Vista Dome Car.

Improved Houdaille hydraulic instruments will provide *both* lateral and vertical control.

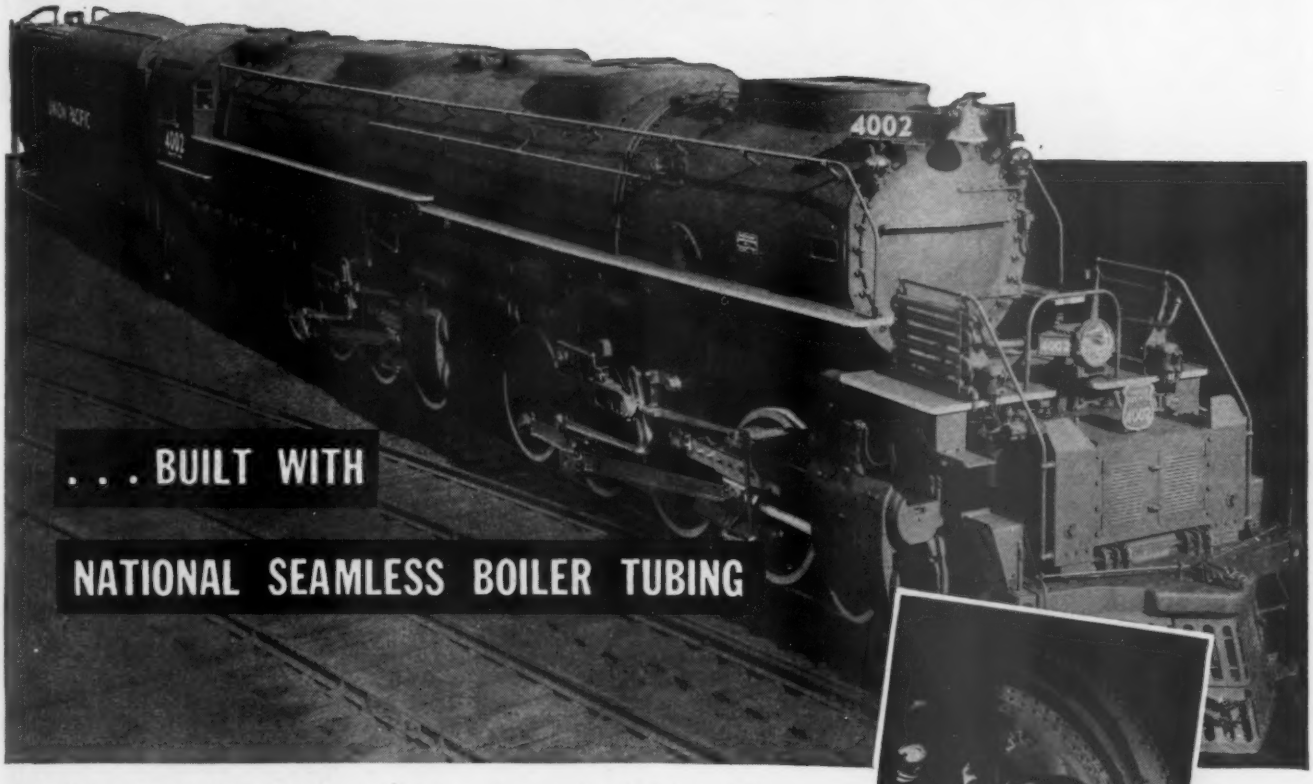
Houdaille Railroad Shock Absorbers stabilize and cushion the operation of America's most famous trains, many of which have seen more than a million miles of service.



HOUDE ENGINEERING DIVISION OF
HOUDAILLE-HERSHEY CORPORATION
MAKERS OF HYDRAULIC CONTROLS
BUFFALO 11, NEW YORK

*Pronounced—Hoo-dye

The "Big Boys" came through in the pinch



Backbone of the Union Pacific's fleet of freight locomotives are these 4-8-8-4 type "Big Boys" which were equipped with NATIONAL Seamless Boiler Tubes.

MORE tonnage has been hauled on American railroads in the last five years than in any similar period in history. On the Union Pacific a huge fleet of these "Big Boys" shouldered a lion's share of materials over the "Rockies."

In this grueling service, NATIONAL Seamless Boiler Tubes set an amazing record for reliability. They helped to keep the "Big Boys" on the job and out of the repair shops.

On railroad after railroad, shop superintendents have told us how NATIONAL Seamless represents the ultimate in the manufacture of boiler tubes. The reason for this is not hard to find. Only the best steel can be used in the seamless process. The piercing operation is in itself an exploratory test and would bring to light the minutest defect in the steel used in manufacturing the tube. Seamless tube walls are uniform . . . there is no longitudinal weld that might offer a starting point for failure. As a result, Seamless Boiler Tubes are as near perfect as any that can be made.

In the years ahead, the savings made possible by NATIONAL Seamless Boiler Tubes will be well worth considering. Write for more information on your next job.

RE-TUBE WITH NATIONAL SEAMLESS

ADVANTAGES OF NATIONAL SEAMLESS BOILER TUBES

Seamless—No uncertainty about full wall strength in every tube.

Higher Creep Strength—only "killed" open hearth and electric furnace steel used.

Uniform Density and Soundness — improved heat transfer characteristics.

Exceptional Ductility — every tube completely annealed — readily manipulated — lowest installation costs.

Thorough Uniformity—assured by careful metallurgical supervision.

Over 50 years' proved performance under exacting service. Comply with all recognized specifications —water-tube or fire-tube boilers.

WALLS WITHOUT WELDS

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Tubing Specialties Division

NATIONAL TUBE COMPANY · USS STEEL · UNITED STATES STEEL

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

HOME for them!

and the HOME STRETCH for YOU!

You still have time! In December, your employees' allotments to the Victory Loan through your company's Payroll Savings Plan offer a final chance to help speed the proud homecoming of our fighting men—and do all in medical power for our hospitalized heroes!

Make December a plantwide TOP-THE-QUOTA drive! Now's the time to spotlight your Payroll Savings Plan—and "brief" your Bond-selling organization for fast, last minute action!

***Resolicit every employee to buy the* New F.D.R. Memorial $200 Bond**

The new Franklin Delano Roosevelt $200 Bond—better than actual cash because it earns interest—is a strong building stone toward the secure future of every employee-purchaser!

From now 'til the New Year—with plant rallies, interdepartmental contests and resolicitation—keep Payroll Savings Plan Bond-buying at a new Victory Loan high! Buying a Victory Bond is the best way of saying "Welcome Home" to our returning veterans! Also an active aid in assuring prosperity to your nation, your employees—and your own industry!

VICTORY LOAN

The Treasury Department acknowledges with appreciation the publication of this message by

RAILWAY MECHANICAL ENGINEER

This is an official U.S. Treasury advertisement prepared under the auspices of the Treasury Department and War Advertising Council

OPPORTUNITY FOR CAR DESIGNERS TO STEP UP PAYLOAD

That's one big reason why these strong, tough steels were developed —to help designers of railroad equipment to convert profit-eating deadweight into money-making payload.

And here is how it's done.

Republic High Strength Steels have a minimum yield point of 50,000 pounds per square inch which, combined with essential resistance to atmospheric corrosion, permits the use of thinner sections without sacrifice of service life.

In a hopper car this means greater payload capacity without increase in deadweight. In a box car it means more payload per pound of deadweight, or less power consumed per ton-mile of paying freight. Experience has proved that the use of Republic High Strength Steels throughout freight car bodies can result in a deadweight reduction of 25% — and, also, in substantially-reduced maintenance costs.

So that designers and builders may realize greatest benefits, Republic produces three high strength steels —Republic ALDECOR, Republic COR-TEN and Republic DOUBLE STRENGTH in sheets, strip, plates and bars. Although similar in physical properties, certain differences in forming and welding characteristics may make one more suitable for you than the other two.

Republic's metallurgical staff is ready now to work with you in determining how best to use these steels in replacing obsolete, cumbersome equipment with stronger, lighter cars of all types.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Bldg., New York 17, N. Y.

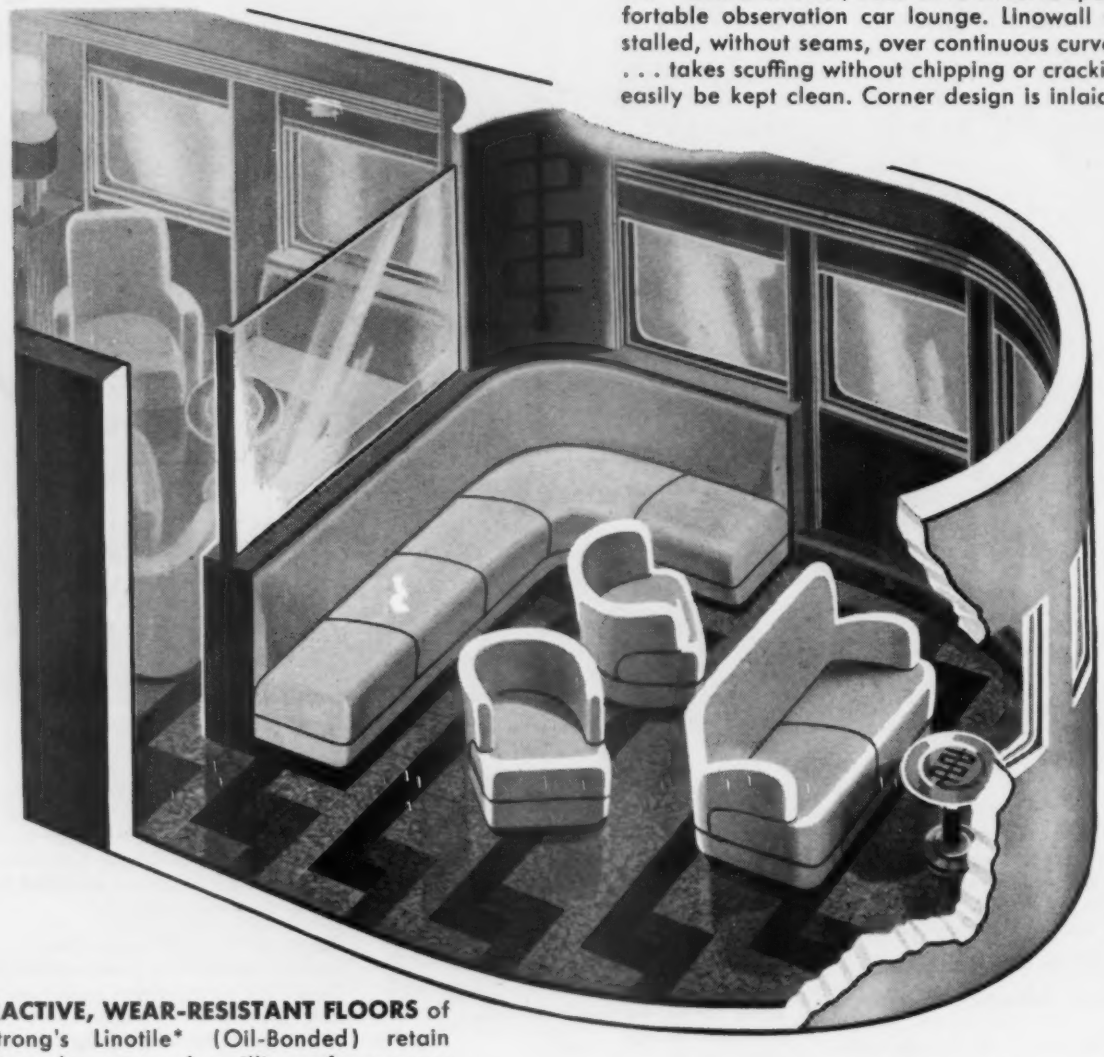
Republic
HIGH STRENGTH STEELS
ALDECOR • COR-TEN • DOUBLE STRENGTH

Other Republic Products include Carbon, Alloy and Stainless Steels — Sheets — Plates — Pipe — Bars, Rods and Wires — Boiler Tubes

ADVANCE STYLE NOTES FOR PASSENGER CARS

Observation Cars

STREAMLINED sidewall surfaces of Armstrong's Linowall* add a colorful, decorative effect to spacious, comfortable observation car lounge. Linowall can be installed, without seams, over continuous curved surfaces . . . takes scuffing without chipping or cracking . . . can easily be kept clean. Corner design is inlaid.



ATTRACTIVE, WEAR-RESISTANT FLOORS of Armstrong's Linotile* (Oil-Bonded) retain beauty and smartness for millions of passenger miles, provide a wide variety of design possibilities. Top-set cove base facilitates cleaning. Armstrong's Cork Base Underlayment saves weight, resists indentation, can be used over any type of floor plate.

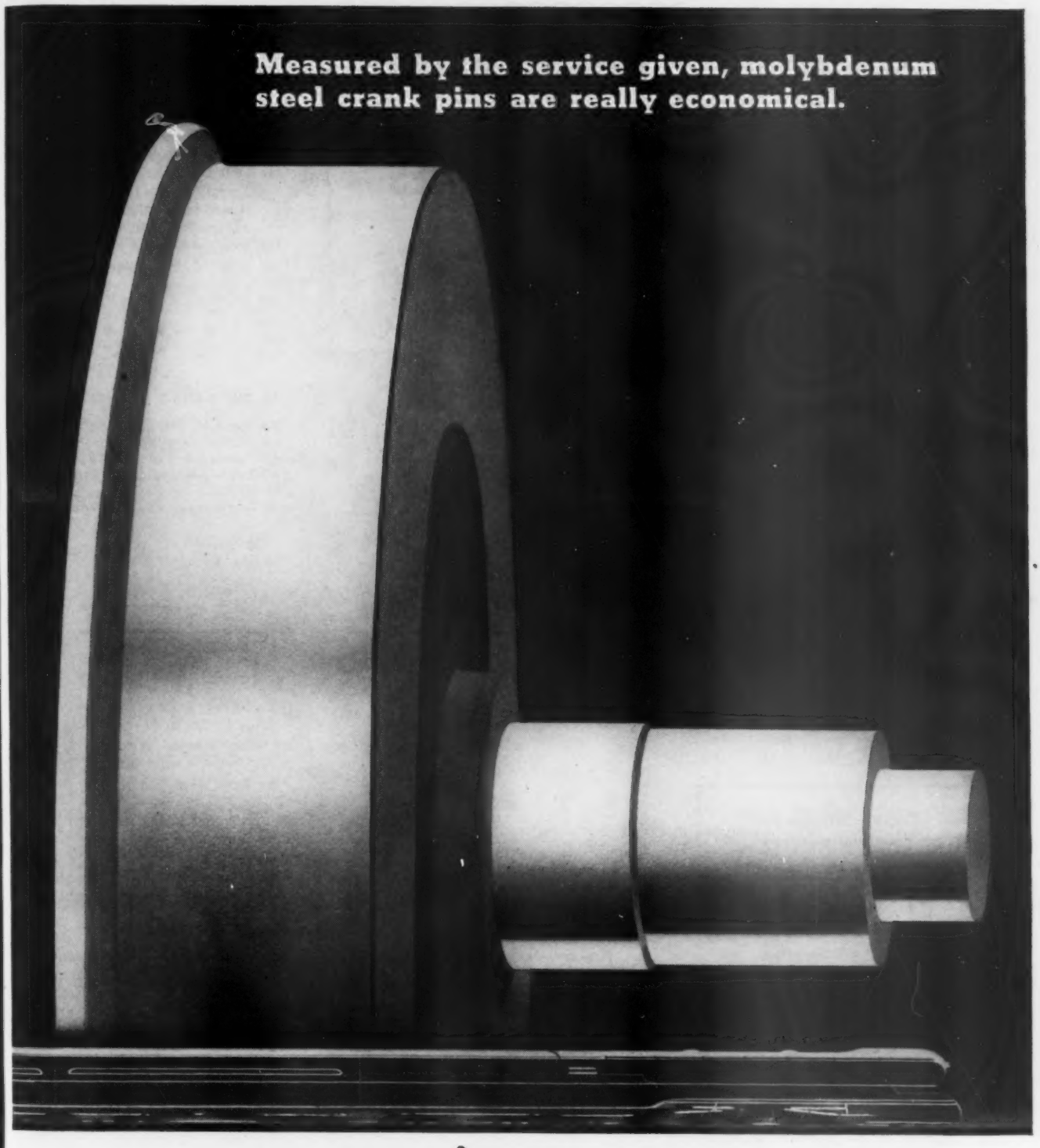
DECORATIVE, SERVICEABLE table top of Armstrong's Linoleum carries out color scheme and appointments of car section. Designs inlaid in linoleum offer unlimited possibilites for unusual decorative patterns. Damp cloth quickly removes dirt and crumbs.

* Reg. U. S. Pat. Off.

PUT ARMSTRONG'S versatile floor and surfacing materials into your car designs. They will help you achieve striking, durable interiors in every type of passenger car. For full information and free samples of Armstrong's Linowall, Linoleum, and Linotile, write to Armstrong Cork Company, Industrial Division, 7412 Arch Street, Lancaster, Pennsylvania.

ARMSTRONG'S
FLOORS and SURFACING MATERIALS
for passenger cars

Measured by the service given, molybdenum steel crank pins are really economical.



CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

MOLY

500 Fifth Avenue · New York City

POINTED RHYMES FOR TRYING TIMES

by
Berton Braley

Here is wisdom by the peck
Versified to save your neck!

DON'T BLOW IT

Oh, workman or scholar,
Hang on to your dollar
And do not spend it soon,
For every cent
Unwisely spent
Inflates the price balloon.

IT MAKES SCENTS

To market (black market) to spend lots of jack
Careless of how many ceilings you crack,
To market (black market) where prices are dear,
—Gosh, there's a terrible smell around here.

If

If you can keep your head and calmly ponder
How silly spending drives the prices high;
If you can save the cash you'd like to squander
And only buy the things you need to buy;
If you can do your part to fight inflation
By simply being thrifty with your pelf,
You'll do a vital service to the nation
And—furthermore—you'll benefit yourself.

Bonds you buy with payroll earnings,
Help fulfill your future yearnings.

NO GAMBLE

When the war is over, will the prices
rise or fall?
We do not know the answer, and
nobody does, at all.
But this much we *can* prophesy—
whichever way they go:
You will find it more convenient if
you've saved a little dough.

★ ★ ★

Money in your pocket,
Take it out and sock it
Into War Bonds, which
Help to make you rich.

DOUBLE AND NO QUITS

When you boost your paycheck quota and allot it
To another bond—it's pretty soft for you!
For, although you've spent your money—you
have got it,
And the Interest is interesting too.

WHO? ME?

There was a little dope with a fat
pay envelope
And she spent every cent that
was in it.
And she wondered, by-and-by,
why the prices rose so high,
But she didn't blame herself for
a minute.

★ ★ ★

INFLATIONARY MARY

Inflationary Mary spills
This silly kind of chatter:
"My little teeny-wee bills
And spendings do not matter.

"And if I cheat a little bit
On rationing and ceilings
The Nation's welfare isn't hit
By my small lawless dealings!"

Inflationary Mary's wrong.
For she'd be much to blame
If people in a mighty throng
Should say and do the same.

Small spendings, in the aggregate,
Reach sums extraordinary,
So let's not try to imitate
Inflationary Mary.

★ ★ ★

ADVERTISERS, PUBLISHERS—NOTE:

You are welcome to use all or any part of the material on this page to aid the fight against inflation.

SNAKE IN THE GAS

There was a crooked man and he
lived in crooked style,
He dealt at crooked markets with a
smugly crooked smile.
He viewed himself as clever with
his crooked ration book,
But everybody knew him for a
crooked little crook.

★ ★ ★

THE GANG'S ALL HERE

You may ask, "Why should *my* spending
Cause inflationary trending
Though I squander every penny I have got?"
—If you're joined by sixty millions
Of civilians blowing billions,
You'll discover that it matters quite a lot!

YOU CAN LAY TO THAT

As the best egg for a nest-egg
Buy a War Bond—buy a batch.
But you gotta keep 'em settin'
Or they ain'ta gonta hatch!

Save your pay
Here's a way—
Bonds and savings and insurance
Give your future more endurance.
Mrs., Mister,
Brother, Sister,
Don't compete in buying things
That is whence inflation springs.

ONE PERSON CAN START IT!

You give inflation a boost

—when you buy anything you can do without
—when you buy above ceiling or without
giving up stamps (Black Market!)
—when you ask more money for your services
or the goods you sell.

SAVE YOUR MONEY. Buy and hold all the War Bonds you can afford—to pay for the war and protect your own future. Keep up your insurance.

A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of America.

Stepped-up schedules will mean more wear and tear on motive power in the days ahead. To help prevent costly breakdown delays—keep your locomotives out of the backshop—standardize on unfailing

N·B·M ENGINE CASTINGS AND BEARINGS

N·B·M

NATIONAL BEARING DIVISION

ST. LOUIS • NEW YORK

AMERICAN Brake Shoe COMPANY

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

52,525 miles in two months

A TRIUMPH OF "ALCO Balanced Power!"

THIS huge mileage was rolled up on the difficult "Commodore Vanderbilt" run between Harmon and Chicago, during August and September. Average haul was 14 to 15 heavy Pullmans at 56.2 miles per hour over the 925 mile run.

ALCO BALANCED POWER, embodying boldly improved design features perfectly coordinated, jointly developed by American Locomotive and New York Central engineers, produced an unprecedented combination of speed, power and operating flexibility in this great steam locomotive.

Because of its great speed, power and extraordinary design flexibility, the "Niagara" can be operated without sacrifice of efficiency in either fast freight or passenger service.

In this new "Niagara", ALCO BALANCED POWER in steam locomotive design establishes for the railroad industry a new high level of steam motive power economy.

ALCO Balanced Power

Design Features in the "Niagara"

Salient features contributing basically to ALCO BALANCED POWER in the "Niagara" include:

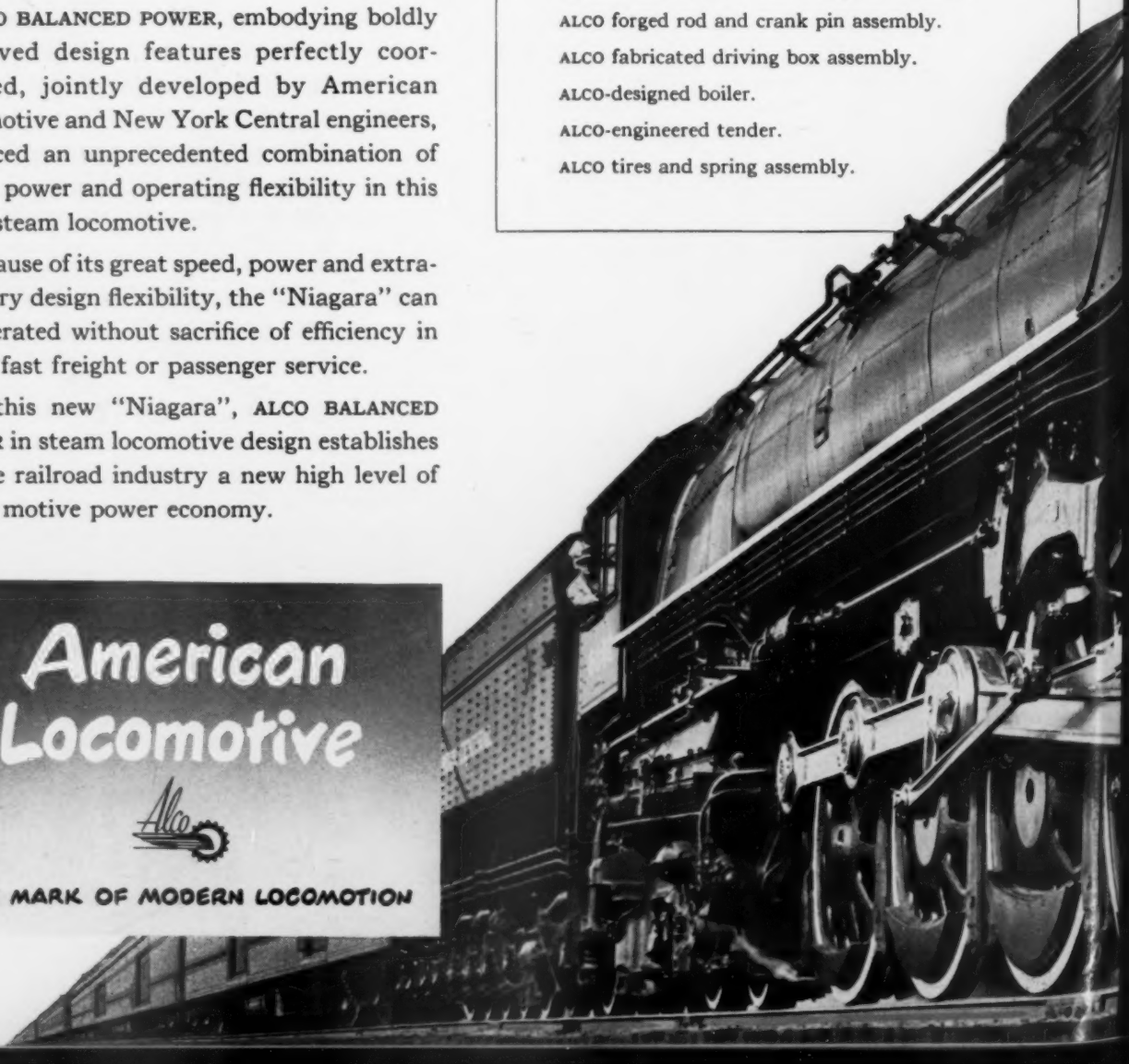
ALCO forged rod and crank pin assembly.

ALCO fabricated driving box assembly.

ALCO-designed boiler.

ALCO-engineered tender.

ALCO tires and spring assembly.



American Locomotive

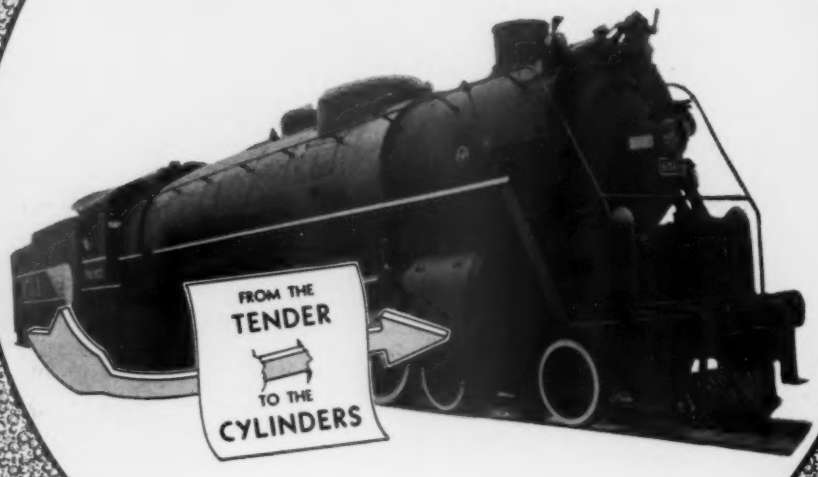
Alco

THE MARK OF MODERN LOCOMOTION

BY NEW YORK CENTRAL'S
NEW "NIAGARA" LOCOMOTIVE

FEED WATER HEATING
By Coffin

PROMOTES LOCOMOTIVE EFFICIENCY



OVER 100,000 MILES, 1 YEAR OF SERVICE, WITHOUT MAINTENANCE IS INDICATIVE OF COFFIN DESIGN AND DEPENDABILITY.

Send For Descriptive Bulletin

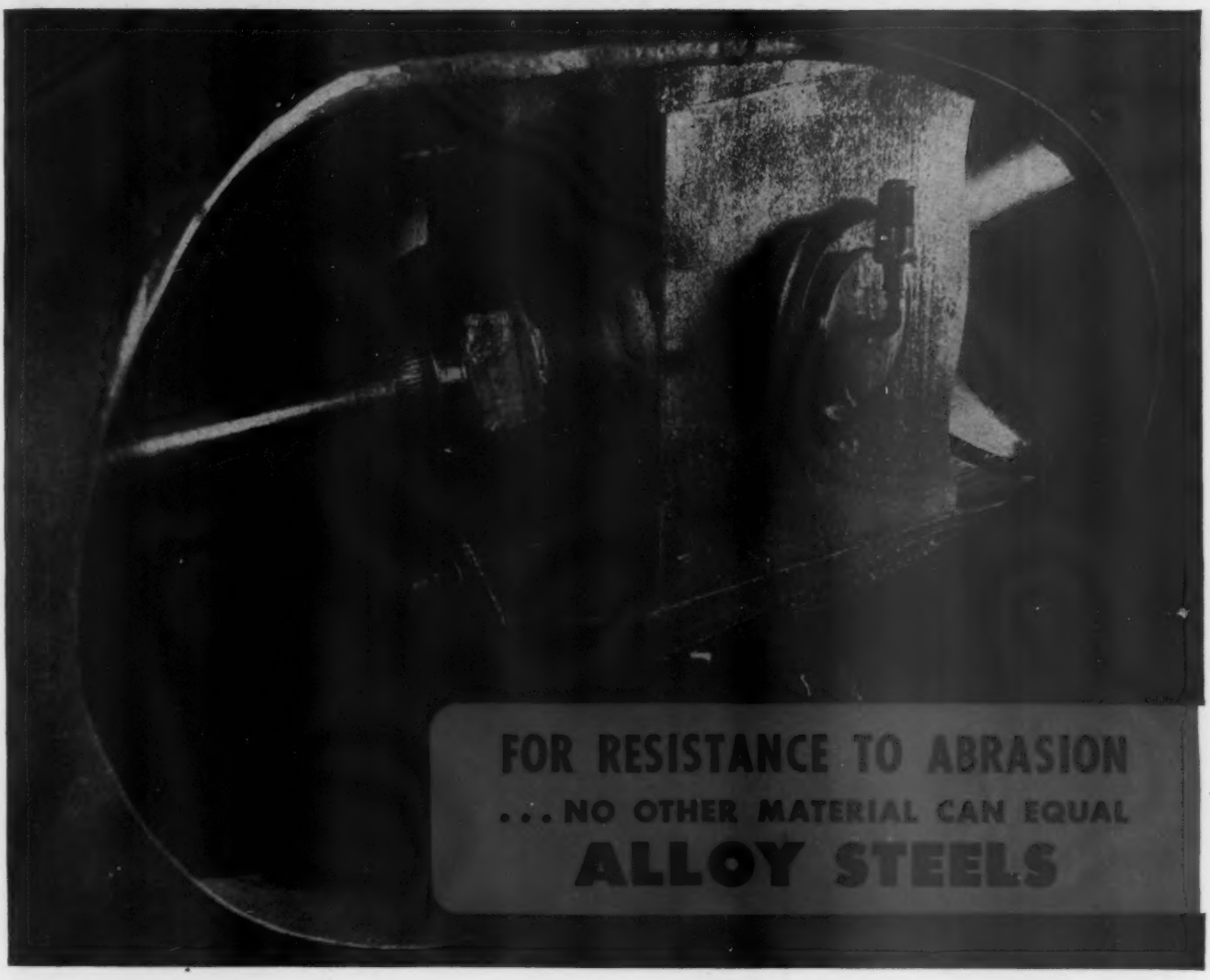
THE J. S. COFFIN, JR., COMPANY
ENGLEWOOD, NEW JERSEY

PLEASE SEND FEED WATER HEATER BULLETIN

NAME _____

COMPANY _____

ADDRESS _____



● When locomotive parts like that above, or any machine parts with bearing surfaces, slide back and forth, or turn 'round and 'round, there's bound to be abrasion. And abrasion means wear, unless the parts that slide and turn are hard enough to resist abrasion.

When it comes to hardenability, no other material can equal alloy steels. That's why so many vital operating parts in all kinds of equipment are made of these finest of steels.

Alloy steels can be surface hardened or deep hardened to predetermined degrees of hardness with greater assurance of results than any other material. Their uniform response to hardening insures against non-hardened areas or soft spots in wearing surfaces.

But that's only one advantage of using alloy steels. Their high strength-to-weight ratio permits the use with safety of lighter equipment and smaller sections. Their super-toughness provides protection against severe shocks, reversal of stresses or sudden overloading. Their resistance to fatigue, heat, cold and corrosion means long life and lower costs for equipment in which they are used.

Would you like to know what alloy steels can do for you? Republic—world's leader in this branch of steel making—is ready to tell you whenever you're ready to listen.

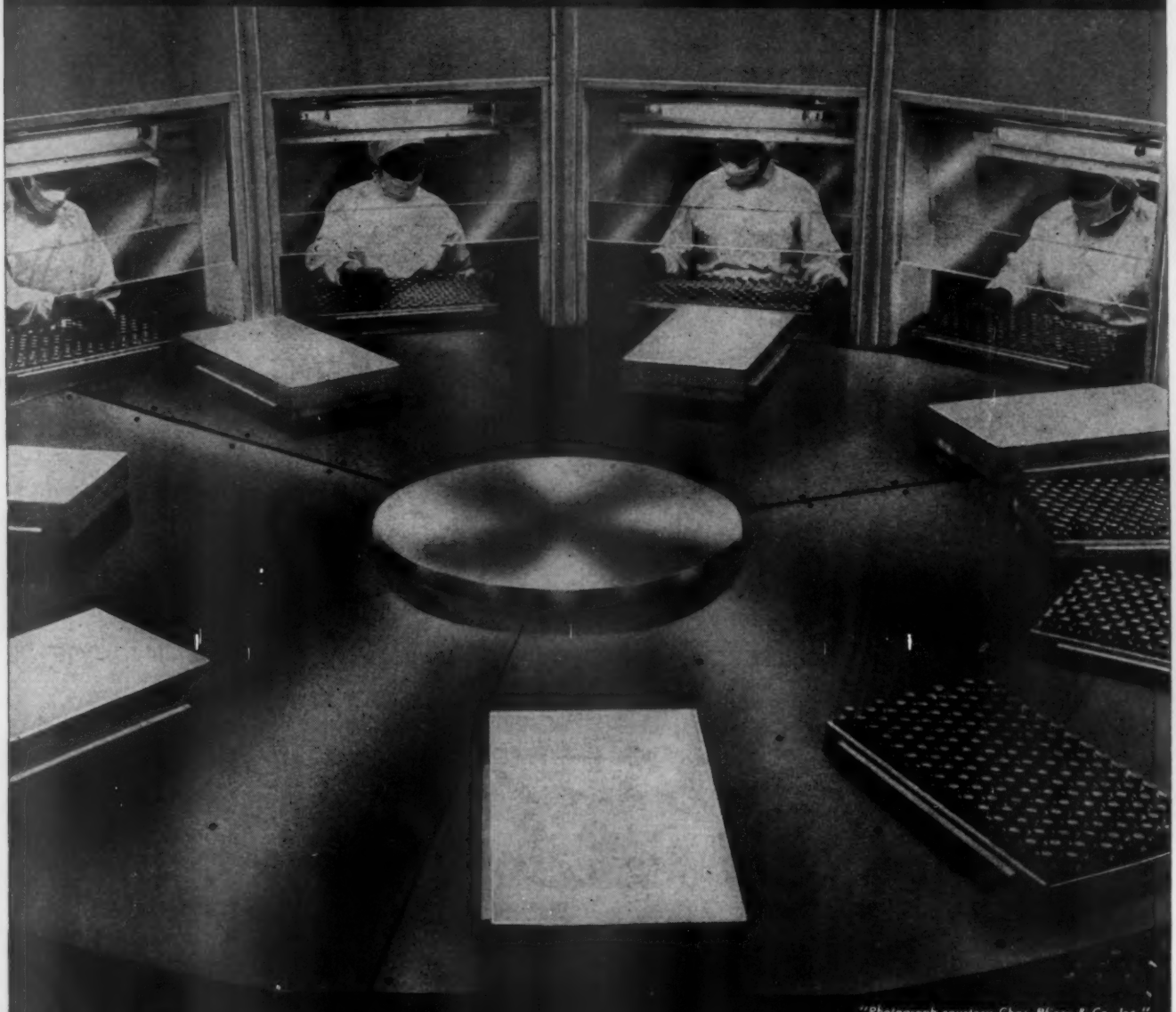
REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

Republic
ALLOY STEELS

Also Carbon and Stainless Steels—Sheets, Plates—Pipe—Upset Bolts, Nuts and Rivets—Electronic Boiler Tubes

STAINLESS STEELS

Most versatile of modern metals...their unique combinations of properties merit your consideration in designing for the future.



"Photograph courtesy Chas. Pfizer & Co., Inc."

Packaging the miracle drug... penicillin...calls for completely sterile conditions. Here the table must be the very acme of aseptic cleanliness... easy to clean and keep clean. Hence, it's chromium-Nickel stainless steel.

• • •

International Nickel are miners, smelters and refiners of Nickel, an important ingredient of the stainless steels, but do not produce stainless steels. If interested, please communicate with your established sources of supply for stainless steels.

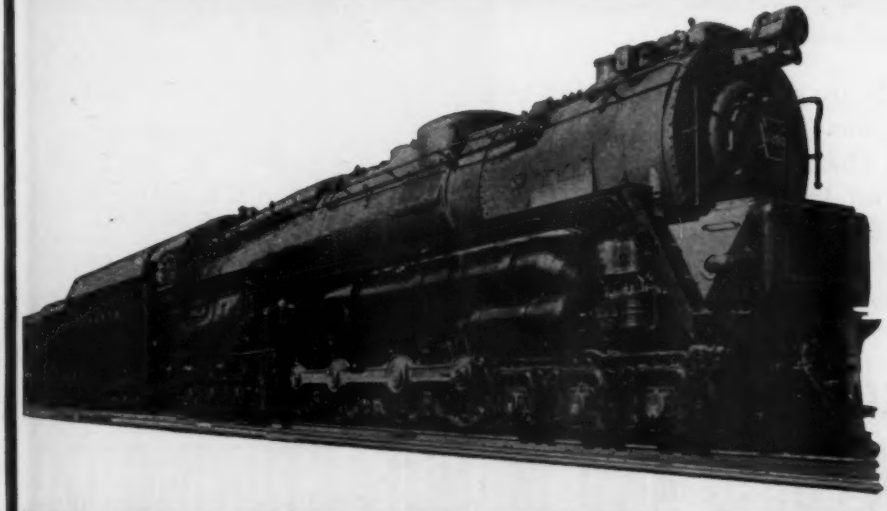
THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N.Y.

LATEST IN PENNSYLVANIA POWER

All TIMKEN ROLLER BEARING EQUIPPED

Class Q-2 Type 4-4-6-4 designed for hauling heavy freight trains at higher speeds. Equipped with Timken Bearings on engine trucks, driving axles, trailer trucks. 26 locomotives in service.

Class T-1 Type 4-4-4-4 for high-speed passenger and fast freight service. Engine trucks, driving axles, trailer trucks, all mounted on Timken Bearings. Also equipped with Timken driving rods, crank pin bearings, light weight reciprocating parts. Two locomotives in service and fifty under construction.



Class S-2 Type 6-8-6 direct drive steam turbine locomotive for high-speed passenger and fast freight service. All axles, including driving axles, and side rod crank pins mounted on Timken Bearings.

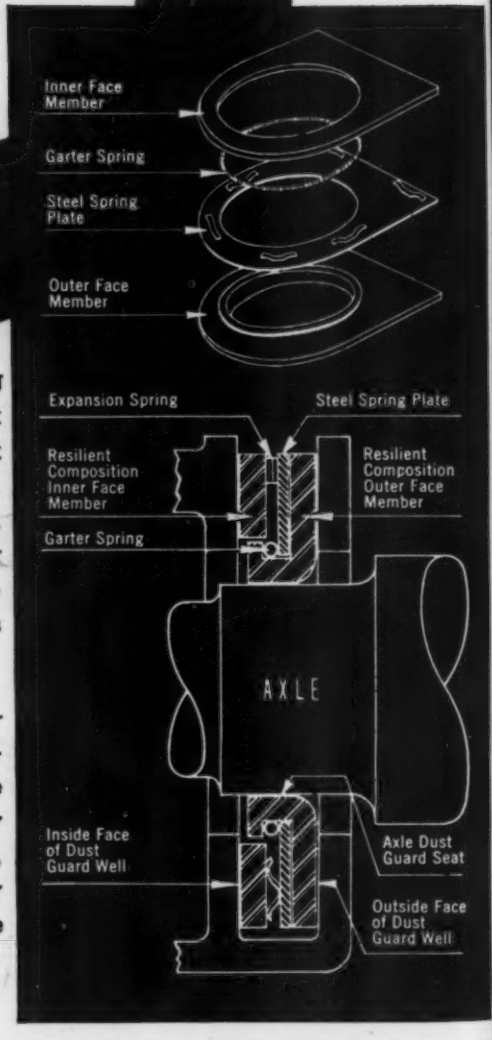
THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

NEW!

AMWELD

E-X-P-A-N-D-I-N-G

dust guards



Give 100% seal

AMWELD Expanding Dust Guards assure positive protection against dust, water and grime in journal boxes. The complete unit consists of only four pieces — two composition face members, metal plate with six spring steel springs and a garter spring. All metal is completely cased to avoid any possibility of wear on the axle. The springs hold the guard snugly against the inside and outside faces of the dust guard well — expand as required and provide a perfect seal at all times.

AMWELD Expanding Dust Guards are sturdily constructed — no loose parts and are applied without tools. They fit all standard AAR journal boxes without change. Their performance is not affected by oil, moisture, dust, ice or temperature. They protect journal packing, reduce lubrication troubles and costs, and minimize hot boxes because the boxes stay sealed. They increase the life of bearings, journals and packing. For more detailed information write.

RAILWAY EQUIPMENT DIVISION

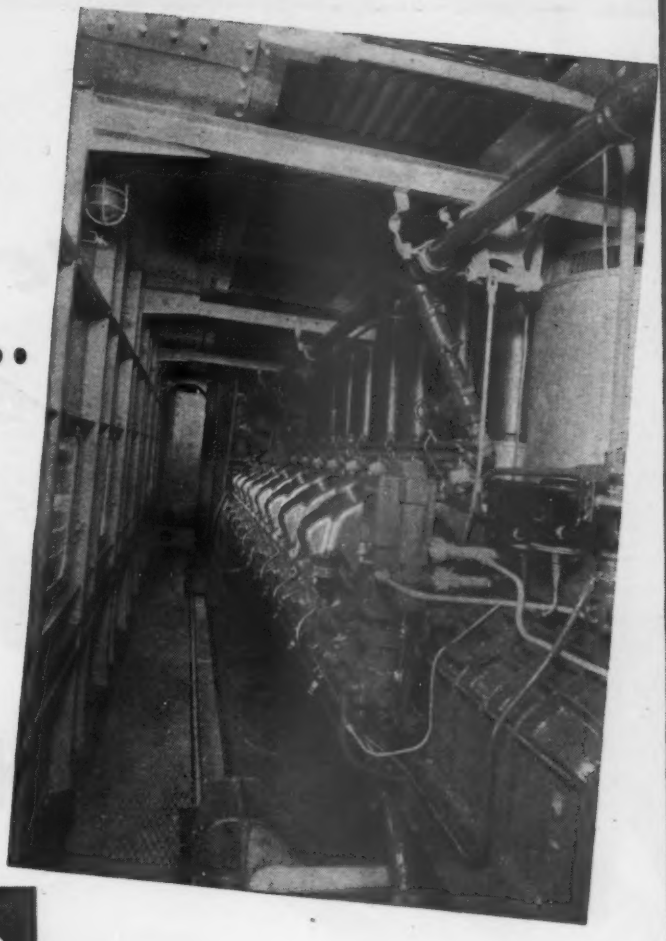
THE AMERICAN WELDING AND MANUFACTURING CO.

WARREN, OHIO

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Tough enough for break-ins... gives long, clean service



NONPAREIL HD
DIESEL OIL

ENGINE BUILDERS and many operators use Nonpareil HD Diesel Oil as a break-in oil. They find it provides smoother break-ins with no scratching or scuffing of pistons in cylinders. The detergent quality in Nonpareil HD helps remove the finely divided metal particles resulting from wear in the break-in period. The oxidation inhibitor prevents excessive heat, usually accompanying a break-in, from oxidizing the oil to form varnish and other deposits.

These same excellent qualities provide unusual freedom from wear and deposits in continuous operation under heavy-duty service.

The next time you break in an engine use Nonpareil HD—get off to a good start. Then continue to use Nonpareil HD and see how it lowers cleaning and maintenance costs.

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill.

Buy and hold more Victory Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

WOVENSTONE

THE PROVEN

Operating tests prove that **INSUTAPE** eliminates 64% of bare pipe heat losses. Savings have been proved under still air conditions, but are much greater under wind velocity conditions found in the actual operation of rolling stock.

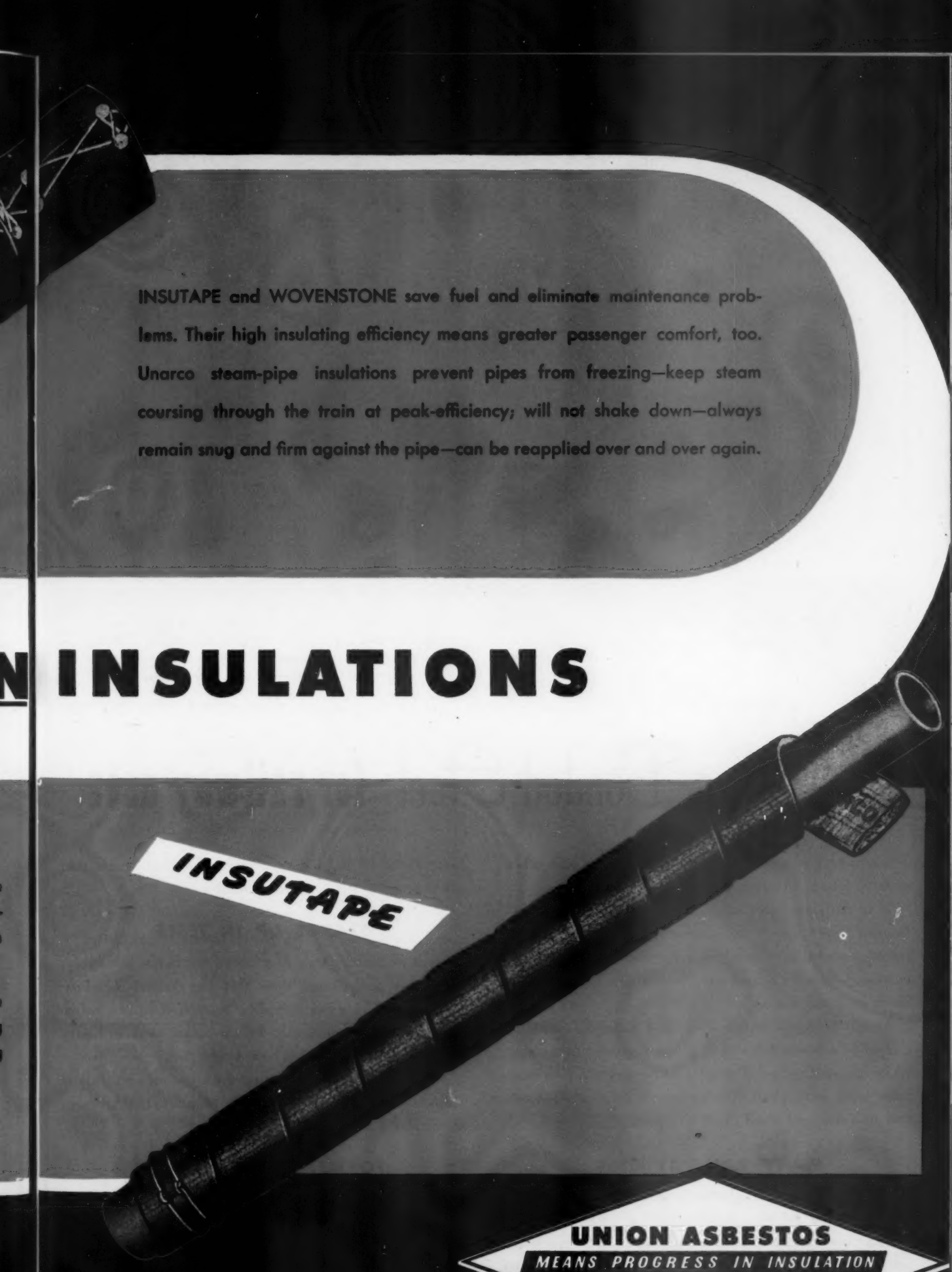
WOVENSTONE has proved its efficiency in 12 years of *"active service."* Many mechanical men can point with pride to rolling stock that is still equipped with its original Wovenstone—rolling stock placed in service over 12 years ago!

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

310 S. MICHIGAN AVENUE

INSUTAPE and WOVENSTONE save fuel and eliminate maintenance problems. Their high insulating efficiency means greater passenger comfort, too. Unarco steam-pipe insulations prevent pipes from freezing—keep steam coursing through the train at peak-efficiency; will not shake down—always remain snug and firm against the pipe—can be reapplied over and over again.

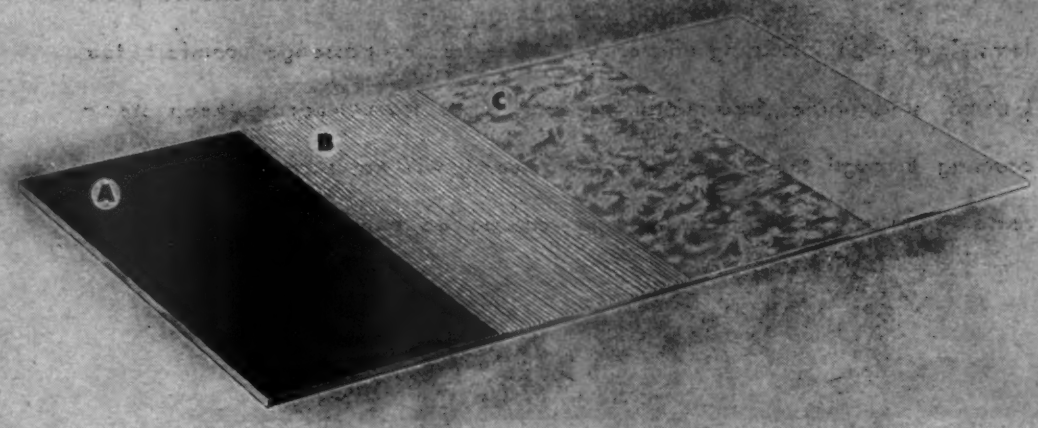
N INSULATIONS



UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

E CHICAGO 4, ILLINOIS

Here is Armco's newest special coated sheet...



This drawing shows the composition of ARMCO Asbestos-Bonded sheet steel. (A) indicates the asphalt coating on the asbestos fibers (B). These are embedded in the galvanized coating (C) on a sheet of open hearth or copper steel.

Asbestos-Bonded Steel for railway uses

The newest specialty sheet steel for car parts and other railway uses is "ARMCO Asbestos-Bonded Steel."

It is the sheet steel counterpart of ARMCO Asbestos-Bonded Steel Pipe—used successfully for many years in better-grade railroad drainage structures. Now this special corrosion-resistant coated steel is available in sheet form in 16 gage and heavier.

ARMCO Asbestos-Bonded Steel has a coating of zinc with a layer of asbestos felt that is firmly pressed into the zinc while it is still molten. The asbestos felt layer is then saturated with hot asphalt. The surface is relatively smooth and uniform and is off-black in color.

MANY RAILWAY USES

Because it has exceptional resistance to acids, alkalies and water, ARMCO Asbestos-Bonded Steel is ideal for many railway uses. These include interior parts of refrigerator cars and refrigerated express cars, passenger car flooring, various freight car roofing parts, smoke jacks and blast plates.

It is also excellent for other "hidden" sheet steel parts that cannot be painted regularly—especially parts that are exposed to steam or condensation.

STANDS UP IN TESTS

Various laboratory tests in aqueous salt baths, salt spray, acids, and underwater show that the ARMCO *Asbestos-Bonded coating gives complete protection to the galvanized coating underneath.* In the same tests ordinary galvanized coatings failed completely.

The Asbestos-Bonded coating thickness on each side is from .008 to .010 inch. This is in addition to the thickness of the zinc coating.

FORMS, WELDS READILY

Under proper conditions ARMCO Asbestos-Bonded Steel can be rolled and formed in a brake without damage to the coating. It can be bent to an angle of 180° over a diameter of 4 times the thickness of the sheet. For severe forming, the temperature of the steel should be between 90° and 110°F.—never under 70°.

This sheet steel can be arc or acetylene-welded.

Right-angle bends are no problem for ARMCO Asbestos-Bonded Steel when proper radius and clearance are used.

When temperature conditions are normal, rolling does not damage the asbestos-bonded coating.

WEIGHT DATA

Gage numbers in the following table apply to the galvanized steel without the asbestos-bonded coating. The table gives the weight comparison per square foot for various gages, after coating:

Gage	Galvanized Wt. Per Sq. Ft.	Asbestos-Bonded Wt. Per Sq. Ft.
16	2.656 lbs.	2.821 lbs.
14	3.281 lbs.	3.446 lbs.
12	4.531 lbs.	4.696 lbs.
10	5.781 lbs.	5.946 lbs.
8	7.031 lbs.	7.196 lbs.

OTHER SPECIAL-PURPOSE ARMCO SHEET STEELS

HIGH STRENGTH STEELS

Save weight, boost pay loads

STAINLESS STEELS

Save weight, reduce maintenance

PAINTGRIP

Takes paint readily—holds it

ZINCGRIP

Zinc coating won't peel in drawing operations

WRITE FOR DETAILS

You are invited to test ARMCO Asbestos-Bonded Sheets in your own equipment—wherever a corrosion-resistant steel is needed. Our metallurgists will be glad to work with you. Just address The American Rolling Mill Company, 3021 Curtis Street, Middletown, Ohio.

SPECIAL-PURPOSE SHEET STEELS

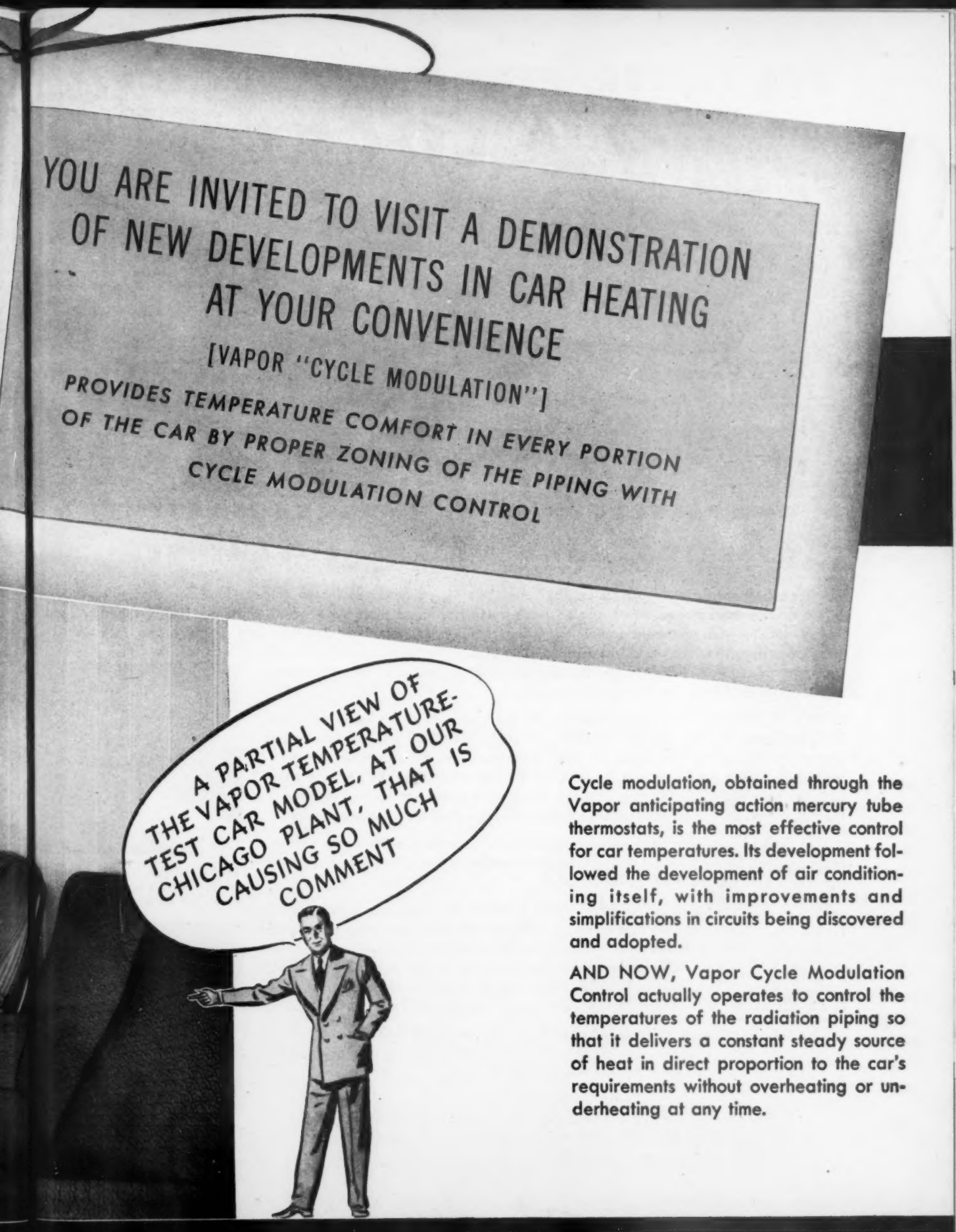
THE AMERICAN ROLLING MILL COMPANY

FOR THE FIRST TIME IN THE HISTORY OF RAILROADING

TEMPERATURE COMFORT IN A PASSENGER CAR IS ACCOMPLISHED BY A STEADY EVEN FLOW OF EXACTLY THE RIGHT AMOUNT OF HEAT FROM THE RADIATION THROUGH THE USE OF THE NEWLY PERFECTED VAPOR CYCLE MODULATION CONTROL

BE SURE IT'S GENUINE VAPOR ENGINEERED
VAPOR SYSTEM
GUARANTEED EFFICIENCY

VAPOR CAR


YOU ARE INVITED TO VISIT A DEMONSTRATION
OF NEW DEVELOPMENTS IN CAR HEATING
AT YOUR CONVENIENCE
[VAPOR "CYCLE MODULATION"]
PROVIDES TEMPERATURE COMFORT IN EVERY PORTION
OF THE CAR BY PROPER ZONING OF THE PIPING WITH
CYCLE MODULATION CONTROL
A PARTIAL VIEW OF
THE VAPOR TEMPERATURE-
TEST CAR MODEL, AT OUR
CHICAGO PLANT, THAT IS
CAUSING SO MUCH
COMMENT

Cycle modulation, obtained through the Vapor anticipating action mercury tube thermostats, is the most effective control for car temperatures. Its development followed the development of air conditioning itself, with improvements and simplifications in circuits being discovered and adopted.

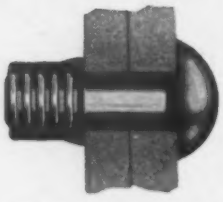
AND NOW, Vapor Cycle Modulation Control actually operates to control the temperatures of the radiation piping so that it delivers a constant steady source of heat in direct proportion to the car's requirements without overheating or underheating at any time.

HEATING CO., INC., RAILWAY EXCHANGE CHICAGO 4, ILLINOIS

FOR FASTER, PERMANENT ASSEMBLY

It's the Huck LOCKBOLT

COLLAR PIN



SECTION THROUGH
DRIVEN HUCK LOCKBOLT

A COMPLETELY *New* TYPE OF FASTENER OFFERING MANY UNIQUE ADVANTAGES

Neither a bolt nor a rivet, the Huck Lockbolt combines the advantages of ***both*** of these fastening devices and offers definite advantages over each. It's more quickly installed than a bolt—pulls the work tightly together before locking—fills the hole completely when required for maximum strength and rigidity—and fastens ***permanently*** without the use of lockwashers, cotterpins or special nuts. Tensile strength is comparable to that of bolts, shear strength equals or exceeds that of conventional rivets, and liberal hole size tolerance is allowed.

HOW IT'S APPLIED The pin is inserted from the back side of the work, the collar is slipped onto the pin, and the driving gun is applied to the pull grooves in the projecting end of the pin. Then, in rapid succession, the gun squeezes the work together between the collar and the head of the pin, wire-draws the pin to a press fit in the hole when hole filling is required, swages the collar into locking grooves in the pin, breaks the pin off flush with the collar, and frees itself from the swaged collar.

Thus the Lockbolt, after accomplishing a bolting-up operation, becomes the equivalent of a rivet, forming a rigid and permanent fastening. Either a hand-operated or a pneumatic gun can be used, as illustrated.

MATERIALS AND SIZES AVAILABLE Huck Lockbolts are available in two types—(1) for applications requiring hole filling (to replace rivets and close-fitting bolts), and (2) to replace bolts in clearance holes. They are furnished with heads of any type desired, and with pins of 24ST aluminum alloy, carbon steel, or high-strength alloy steel. Lockbolts are now available in 3/16" diameter with grip lengths ranging from 1/32" to 21/32" by 16ths. Lockbolts of 1/4" and 5/16" diameter will soon be available.

This DIFFERENT type of fastener may save both time and money on YOUR assembly jobs, whether special or every-day—production or maintenance. Investigate its possibilities! Further information on request.

For applications where the back side of the work is ***inaccessible***, HUCK BLIND RIVETS may be the answer. Bulletin 451 gives full details; may we send you a copy?

Small hand gun is ideal for maintenance jobs. Six to 10 Lockbolts per minute can be driven with this tool.

The fast, light-weight pneumatic gun will drive from 20 to 40 Lockbolts per minute and is recommended for production work.

Huck MANUFACTURING CO.

2480 BELLEVUE AVENUE DETROIT 7, MICHIGAN

ROL-MAN

Self-Renewing Armor Against Abrasive Wear

Rol-Man surfaces cold work-harden with abrasion and impacts; they develop hard, smooth, shiny armors against wear, yet underneath, the metal retains its original toughness to absorb shocks and resist breakage.

As a millionth of an inch of hard surface slowly wears, another millionth of hardness builds up underneath, thus the thickness of the work-hardened section maintains itself despite wear.

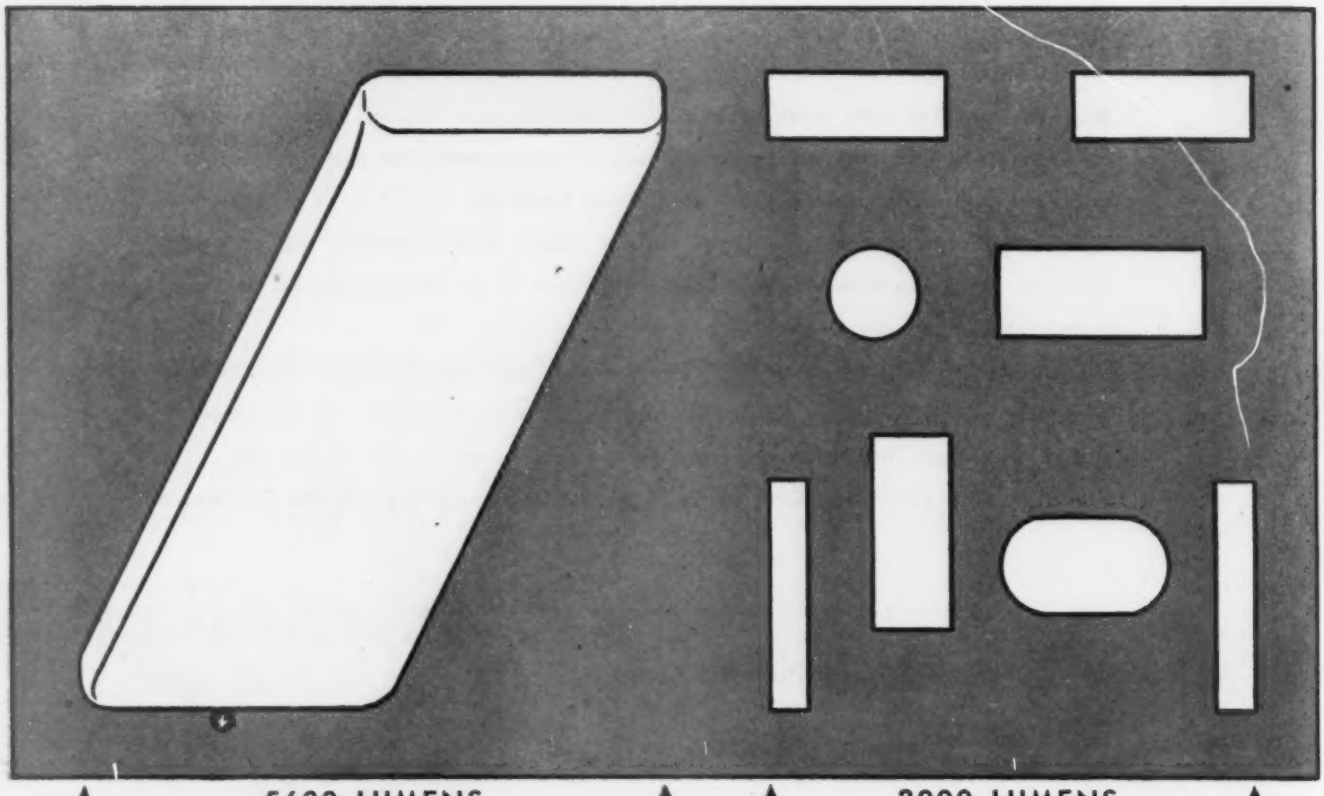
Use Rol-Man High (11% to 14%) Manganese Steel for Passenger Car Truck Swing Hanger Connections, Center Bearing Wear Plates, Pedestal and Box Liners, and all other parts that demand the utmost in abrasion resistance and strength . . . Manganese Steel Forge Co., 2813 Castor Avenue, Philadelphia 34, Pa.

Rol-Man Pins and Bushings are ground to precision diameters. Wear Plates are fabricated to your specifications ready for installation.

PINS • BUSHINGS • WEAR PLATES

Conditioned Lighting

ONE LARGE, GENEROUS SOURCE OF LIGHT.
A SOFT PLEASING GLOW.
AN ABUNDANCE OF LUMENS.
UNOBTRUSIVE BECAUSE IT IS LARGE.
REPLACES MANY SMALL LIGHTING FIXTURES.



FOR TIRELESS READING—Ample diffused illumination where you want it.

WHEN IN FRONT OF A MIRROR—Illumination on your face —not a glare in your eyes—for facial make-up or shaving.

IF MORE LIGHT IS DESIRED, JUST ADD MORE LAMPS TO THIS UNIT INSTEAD OF BUYING MORE FIXTURES, MORE METAL, MORE WEIGHT, MORE WIRING AND MORE COSTLY MAINTENANCE.

YOU CAN NOW GET THESE LARGE FIXTURES BECAUSE—

They require large, light weight transmitting shades now available in "Safety 68" Plexiglas.
They require long lamps now available in fluorescent.
They must have quick easy access to lamps— a Safety Company feature.

THE SAFETY CAR HEATING AND LIGHTING COMPANY, INC.

New York, Chicago, Philadelphia, St. Louis, Boston, San Francisco, Montreal

New York Central
Pennsylvania
Pullman Company
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Missouri Pacific

Is your name here?

Seaboard
Atlantic Coast Line
Southern Pacific
Chicago Burlington & Quincy
Chicago & North Western

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New York New Haven & Hartford
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Northern Pacific

●

Great Northern
Erie Railroad
St. Louis-San Francisco
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Norfolk & Western

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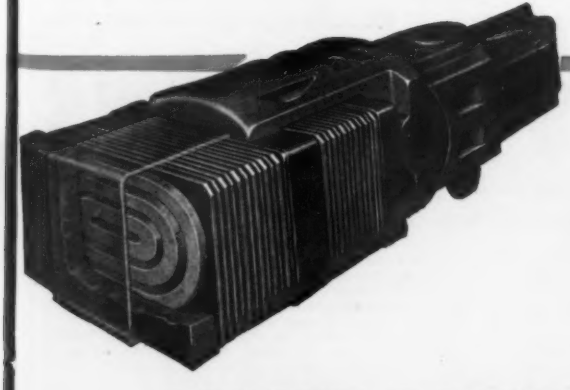
Wabash
Illinois Central
Gulf Mobile & Ohio
Western Pacific
Canadian Pacific

25

PROGRESSIVE AMERICAN RAILROADS

are equipping their newest and finest passenger cars with...



WAUGH MAT *Twin Cushions*

WAUGH EQUIPMENT COMPANY, NEW YORK

Chicago • St. Louis • Canadian Waugh Equipment Company: Montreal

TROUBLES SUBSIDE

It was a slow and troublesome job to drive small slotted screws in fastening a pressed fabric panel on this electrical relay for the P-80 Jet Plane. Frequent driver skids gouged the special fungus-resistant varnish, forced disassembly and junking of marred panels.

OUTPUT HITS STRIDE

Assembly of this part was speeded up 400% when a change was made to Phillips Recessed Head Screws. Fumbling was ended, and a spiral driver could be used, permitting faster driving. Driver skids were eliminated, along with waste of parts and time for disassembly and reassembly.

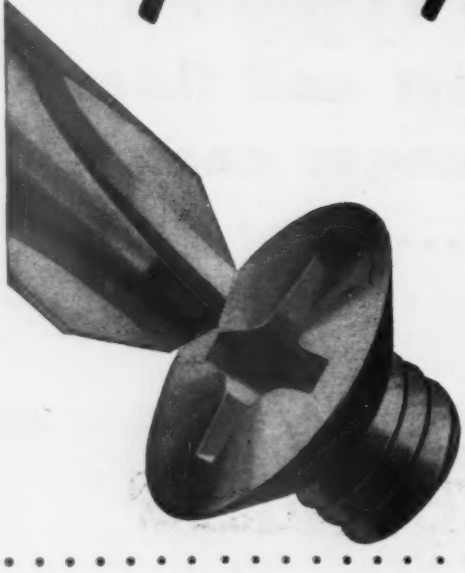
NEW STRENGTH SUPPLIED

Design engineers favor Phillips Screws, because they not only speed output and reduce costs . . . they also permit design improvements that add strength, often with the use of fewer screws. This advantage is especially evident in compact, complicated assemblies.

SHOW IT WITH PRIDE

Wherever screw heads are exposed, the Phillips Recess adds a sales advantage. No unsightly burrs to snag clothing or nick fingers – and sidetrack sales! Its ornamental design blends with modern contours – and it needs only a quarter turn to line up – looks well in any position.

It's Phillips ... the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

25 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
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Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
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Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
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The Southington Hardware Mfg. Co., Southington, Conn.
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Wolverine Bolt Co., Detroit, Mich.

Improved INDUSTRIAL HOSE LINES

In addition to industrial hose, Weatherhead plants make all types of fittings, valves, hydraulic cylinders and other parts for these industries:

AUTOMOTIVE
★
REFRIGERATION
★
RAILROAD
★
MARINE
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FARM EQUIPMENT
★
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Look Ahead with

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND 8, OHIO
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New uses are being found daily for the application of our *improved* industrial hose lines on machinery of all kinds. We manufacture hose assemblies of all types to withstand pressures up to 10,000 P.S.I. They can be equipped with either permanent crimped ends or with re-usable, quick-attachable hose ends. For information or literature write or phone any Weatherhead branch office.

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FIBERGLAS*

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Fiberglas Fibers Do Not Absorb *Moisture*

**Thermal insulations for Passenger Cars,
Refrigerator Cars, Tank Cars and Locomotives.**

***Fiberglas** is sold to Railroads and Car Builders exclusively by*

G-B MFG. CO. ESTABLISHED 1898

GUSTIN-BACON MFG. COMPANY

KANSAS CITY 7, MISSOURI

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All Kinds of Steel Tubing

For Making All Kinds of Parts

...Better...Faster...Cheaper

FINDING the right kind of tubing—Seamless or Welded—for any mechanical requirement is greatly simplified when the problem is put up to Babcock & Wilcox. Matching tubes to jobs—finding the steel analyses best suited for making load bearing and structural parts—is a specialty with B&W.

To this end, metallurgists and technicians are continuously searching for better alloys—testing for proper hardness and hardenability—checking yield strengths, elongation, and tensile strengths against service demands. At B&W your problems are considered in the light of experience with an unusually large variety of analyses, many of them available from no other source; first-hand knowledge of the fabricating, machining, heat-treating, and other capabilities of steels from simple low carbons to high alloys. Making a complete range of both Seamless and Welded Tubing, B&W is in a position to match tubes to jobs without prejudice toward any type or materials. B&W applications are therefore impartial and unbiased.

Perhaps B&W's diversified tubing experience and facilities can help you effect production short-cuts to better machined and structural parts . . . save time, costs and materials. Now is a good time to find out from the nearest B&W office.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.

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"better talk with API"

when it's PINS and BUSHINGS!

The low first cost you look for, and the long wear-life you demand, are BOTH answered in railroad pins and bushings from API. We have the skill and experience that counts . . . plus the right equipment for long, fast production runs. For maintenance replacement or original installation, talk with men who know your problems—and have *the right answers!* An API representative is ready to act fast—now—in your behalf.

AERONAUTICAL PRODUCTS, Inc.

Plant and General Offices: Washington Court House, Ohio.

NEW

The new Monroe Direct-Double-Action *Hydraulic* Shock Absorber especially designed for freight car trucks embodies the same exclusive principles first to be accepted for smoothing the ride on America's high speed crack streamliners. By controlling destructive vibration the new Patented Monroe Direct-Double-Action *Hydraulic* Shock Absorber for freight car trucks cuts vertical and swaying action . . . protects lading . . . prolongs equipment life and reduces roadbed wear. Maintenance costs and damage claims are reduced and cars are kept at work longer. Our Engineers will gladly work with you in the application of this modern new Monroe equipment. Just write, wire or phone our nearest branch office.

RAILWAY SUPPLY DIVISION OFFICES:

Monroe, Michigan
1400 East First St.
Tel.: Monroe 2100

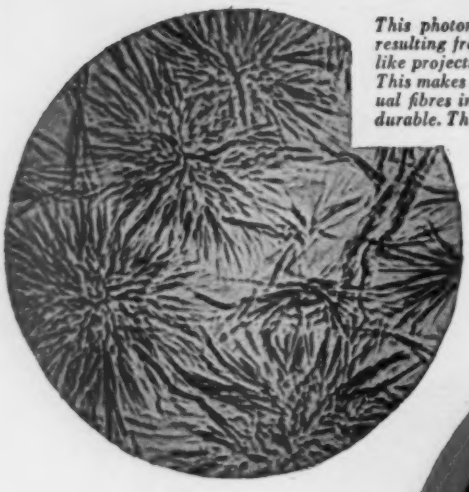
Washington, D. C.
530 Investment Bldg.
Tel.: Republic 1363

Chicago, Ill.
3001 Willoughby Tower
Tel.: Andover 3266

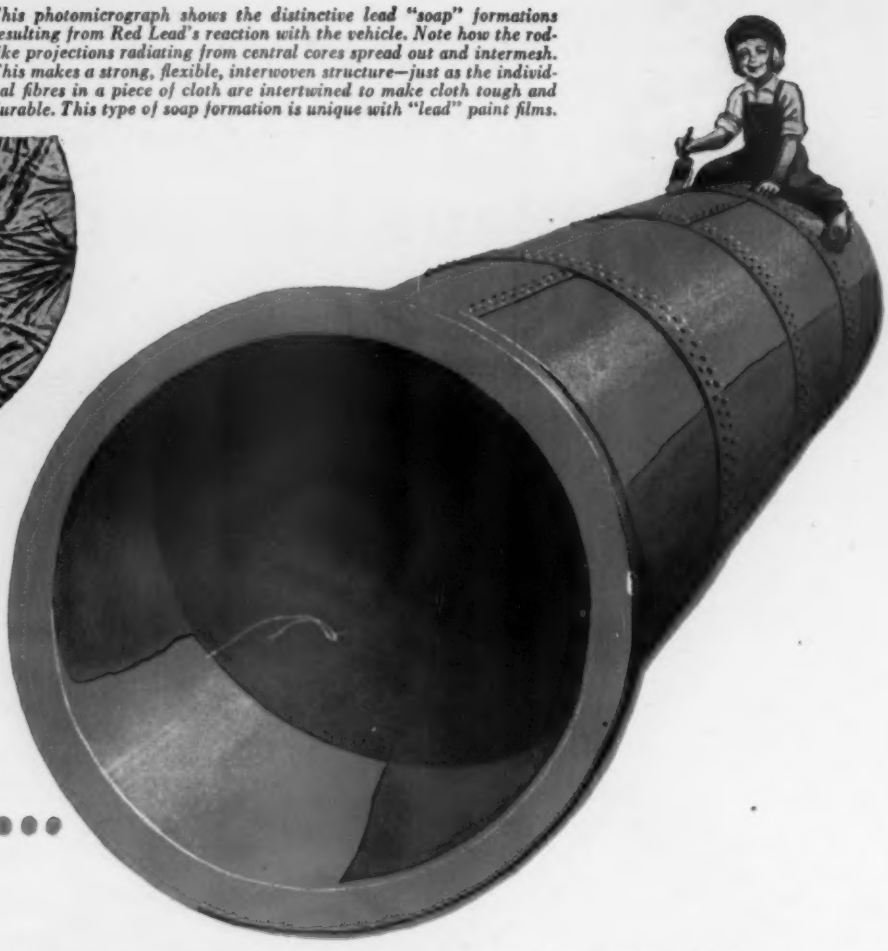
RAILWAY SUPPLY DIVISION

MONROE

ARMY E NAVY



This photomicrograph shows the distinctive lead "soap" formations resulting from Red Lead's reaction with the vehicle. Note how the rod-like projections radiating from central cores spread out and intermesh. This makes a strong, flexible, interwoven structure—just as the individual fibres in a piece of cloth are intertwined to make cloth tough and durable. This type of soap formation is unique with "lead" paint films.



unique LEAD SOAPS...

another important reason why RED LEAD means Extra Rust Protection

Why is Red Lead outstanding as a metal protector?

One of the major reasons is this pigment's remarkable ability to impart to the paint film strong, tough, intertwining lead "soap" formations—as shown in the photomicrograph above.

These unique lead "soaps" improve the paint film in many ways. For one thing, they form a dense, intermeshing matrix which restricts the passage of water through the film. And rusting does not take place without the presence of moisture.

For another, they *mechanically* reinforce the film, giving it extra *strength* and *toughness*.

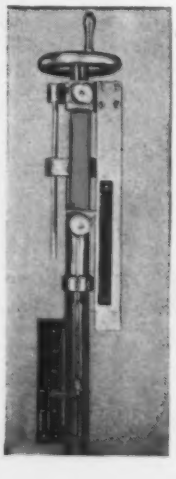
And again, Red Lead "soaps" contribute all-important *elasticity* — allowing movement along their intermeshing projections. This action helps prevent the ruptures to which a hard, unyielding film is subject. Moreover, when a paint film dries and ages, decomposition of the vehicle sets in. But, because of Red Lead's ability to combine with the decomposition products and form soaps, it increases both the durability of the paint film and its adhesion to the base metal.

Red Lead's extra strength, toughness and elasticity are demonstrated by the tensile strength test below and substantiated by exhaustive research and field service.

Remember, too, that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including phenolic and alkyd resin types.

Specify RED LEAD for All Metal Protective Paints

The value of Red Lead as a rust preventive is most fully realized in a paint where it is the only pigment used. However, its rust-resistant properties are so pronounced that it also improves any multiple pigment paint.



* * *

In this tensile strength tester a typical Red Lead paint film has been stretched 18% without breaking. In withstanding this elongation it has maintained a load of 920 grams. Any film that exhibits these characteristics has unusual strength, toughness and elasticity. As metals expand and contract only a fraction of one percent, this film would adhere under the most extreme conditions.

No matter what price you pay, you'll get a better paint for surface protection of metal, if it contains Red Lead.

Write for New Booklet—"Red Lead in Corrosion Resistant Paints" is an up-to-date, authoritative guide for those responsible for specifying and formulating paint for structural iron and steel. It describes in detail the scientific reasons why Red Lead gives superior protection. It also includes typical specification formulas—ranging from Red Lead-Linseed Oil paints to Red Lead-Mixed Pigment-Varnish types. If you haven't received your copy, address nearest branch listed below.

* * *

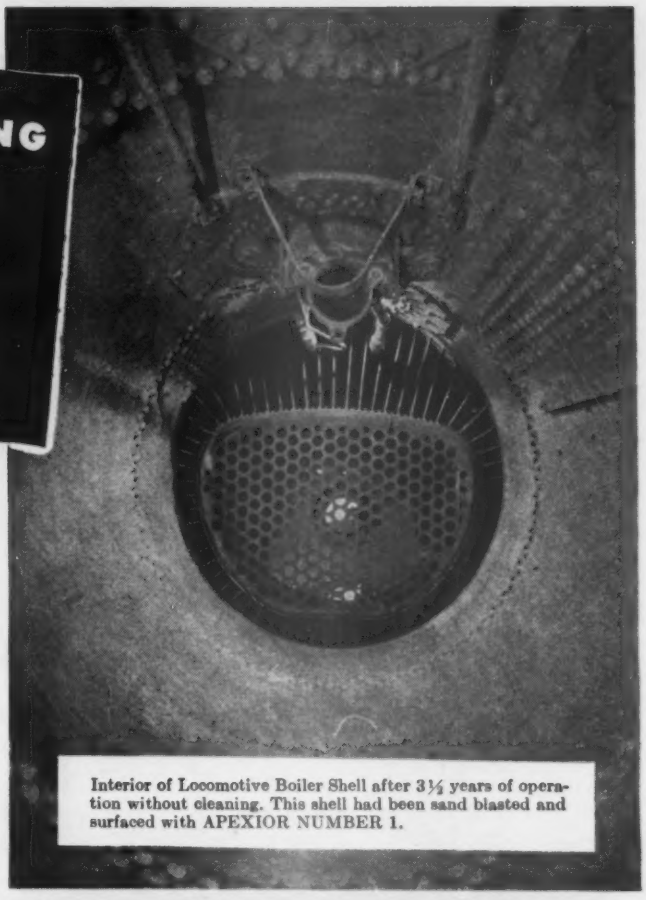
All types of metal protective paints are constantly being tested at National Lead's many proving grounds. The benefit of our extensive experience with Red Lead paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6, Buffalo 3, Chicago 80, Cincinnati 3, Cleveland 13, St. Louis 1, San Francisco 10, Boston 6 (National-Boston Lead Co.); Pittsburgh 30 (National Lead & Oil Co. of Penna); Philadelphia 7 (John T. Lewis & Bros. Co.); Charleston, W. Va. (Evans Lead Division).

DUTCH BOY RED LEAD

HOW APEXIOR SURFACING CUTS LOCOMOTIVE SHOP TIME

Easier Cleaning . . . More Effective Washing . . . Longer Service from Boiler Metal



Interior of Locomotive Boiler Shell after 3½ years of operation without cleaning. This shell had been sand blasted and surfaced with APEXIOR NUMBER 1.

A protective coating of APEXIOR NUMBER 1, a few thousandths of an inch thick, over the water side of locomotive boiler shells and other surfaces exposed to boiler water and steam makes a big saving at shopping time.

APEXIOR retards formation of scale and prevents any chemical bonding with the metal. What scale does adhere comes away easily. Furthermore, an APEXIORIZED surface remains smooth; boiler deposits have little to cling to, and flush away easily.

By preventing water-or-steam contact with metal, APEXIOR NUMBER 1 effectively retards or checks corrosion and pitting in locomotive boilers. Coating water contact areas subject to embrittlement or accelerated stress corrosion has proved effective in minimizing these hazards. The APEXIOR NUMBER 1 coating needs no attention between shoppings.

APEXIOR NUMBER 1 is applied in thousands of locomotive boilers subject to Interstate Commerce Commission inspection.

Supplements Feedwater Treatment

APEXIOR NUMBER 1 is brush-applied and therefore is not a substitute for feedwater preparation or chemical treatment. It is inert to all the chemicals generally used and supplies protection for metal in service under boiler water and steam temperatures and pressures, supplementing the work of the chemist and water service engineer by increasing the durability and raising the service quality of the boiler metal.

APEXIOR NUMBER 3

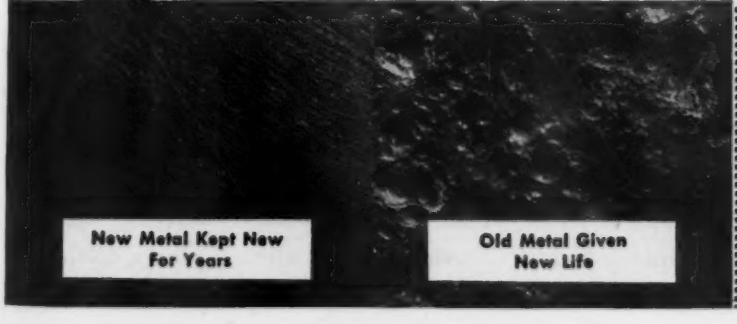
This brush-applied, durable coating protects the water space of locomotive tenders. It air-dries to a chemically inert, shiny-black film, resistant to water or moisture and chemicals used in water conditioning. It does not affect potability of water. Picture shows interior of tender cistern 21 months after surface at right was coated with APEXIOR NUMBER 3. Corroded surface at left was not coated, for comparative test.

See *Locomotive Cyclopoedia*. And write for Bulletin:

APEXIOR

Keeps new metal new . . . Gives old metal new life

DAMPNEY



THE DAMPNEY COMPANY OF AMERICA
Hyde Park, Boston 36, Mass.

Please send free Bulletin.

Name.....

Company.....

Address.....

.....

LEHIGH VALLEY RAILROAD uses the SPICER *Positive* Generator Drive

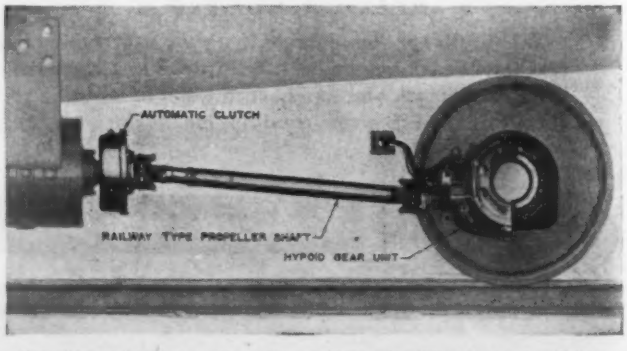
Spicer-equipped trains span the nation. Here's another one—it's a Lehigh Valley Railroad streamliner, and it's one of the more than 2000 Spicer Drive installations used by 27 different railroads all over the country.

The Spicer Positive Generator Drive will help you solve many of the service and comfort requirements of today's railway travel.

The modernization of existing cars, and the development of new cars incorporating high standards of passenger comfort, will require increased and more dependable electrical power to operate satisfactorily with the expanded use of air conditioning, improved lighting, electro-mechanical water coolers, radio, electric kitchen equipment, etc., and other improvements to come. Cars will operate generally at higher speeds and will be much quieter and smoother. All of these are factors emphasizing the importance of using a reliable generator drive.

The simple means of applying the Spicer Drive makes it readily adaptable to both old and new cars with few, if any, changes necessary in the car, truck or axle construction.

Other Spicer features include high efficiency and economy, safety, quietness and smoothness. Write for full details and literature describing *all* the profitable advantages Spicer Positive Generator Drives make available to you.



Exterior and cross-section view of Spicer Positive Generator Drive

42 YEARS OF **Spicer** SERVICE

Positive Generator Drive
Manufactured, Sold and Serviced by
Spicer Manufacturing Corporation, Toledo, Ohio

MODERN HANDLING METHODS

Now a Must!

There's no time to lose in getting operating costs on a competitive peace-time basis. Modern methods of handling are now a *must.* Electric industrial trucks, for example! Palletized loads! And, of course, the newest development in motive power Storage Batteries . . . the sensational Philco "Thirty" that gives 30% longer life! Try Philco "Thirty" in your hardest-working trucks. The tougher the job the better it shows up. Write for the facts today.

● The new Philco "Thirty" Industrial Truck Storage Battery, that gives 30% longer life, is identified by its distinctive red connectors.

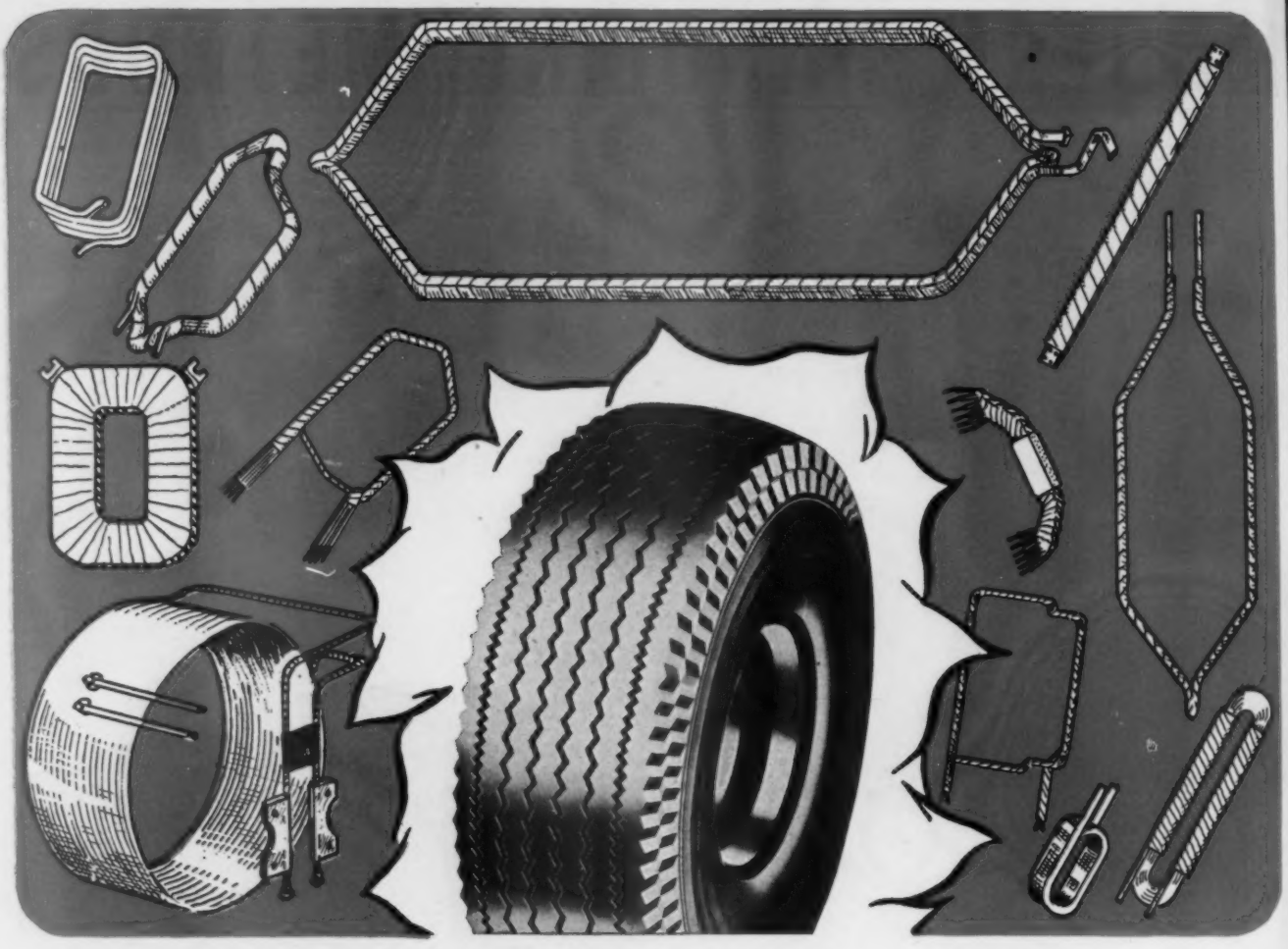
PHILCO

Famous for Quality the World Over

FOR 30 YEARS A LEADER IN INDUSTRIAL STORAGE BATTERY DEVELOPMENT

Tune in The Radio Hall of Fame, with Paul Whiteman and His Orchestra, Sundays, 6 P.M., EST; The Breakfast Club with Don McNeill, 9:45 A.M., EST, Monday through Friday—ABC (Blue) Network

PHILCO CORPORATION · STORAGE BATTERY DIVISION · TRENTON 7, NEW JERSEY



SECOND-GRADE TIRES DON'T PAY . . .

And the Same Goes for Electric Coils

• Tires and coils have one big thing in common. The man who depends on automobile travel to make his living buys the best tires he can find . . . the operation which depends on electric power needs the best coils which can be had. Premature failure means lost production in either case.

Four-ply tires are standard on new passenger cars. But the hard-riding salesman puts six-plies, or "deluxe" four-plies, on his car. He wants no tire trouble; he wants to reach that appointment on time. Do you?

National coils "get you there on time." When standard construction can do the job, we furnish the best. But no rigid production-line technique cripples our ability to design and build special coils to overcome the causes of persistent, recurring coil trouble. When your electrical unit fails, call in National . . . the failure will be analyzed to determine its cause . . . replacement coils will be engineered to give you the longest possible coil life under the conditions imposed. If your conventional winding is merely changed to Mica-Glas or your old winding is completely modernized, it is because the change will benefit you in lower operating and maintenance costs.

Call in National. It will pay you.

NATIONAL ELECTRIC COIL COMPANY

★ **COLUMBUS 16, OHIO, U. S. A.** ★

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—

TRADE MARK

REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

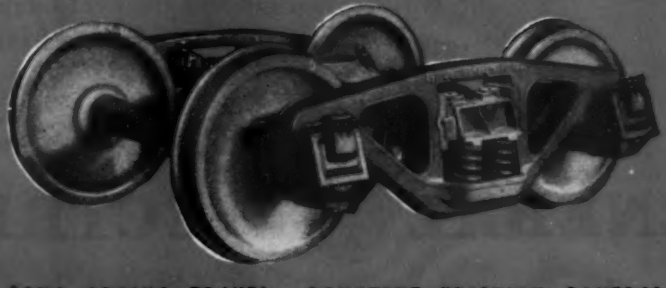
Coil springs develop their best riding qualities in the A.S.F. Ride-Control Truck. Constant friction control prevents spring resonance, yet allows maximum possible freedom of movement for natural cushioning effect—gives lading a smooth ride at all loads and speeds.

MINT-MARK OF ⬡ FINE CAST STEEL

Over 17,200 sets of this modern freight car truck are already in service or on order by 44 railroads and private car owners.

A·S·F *Ride-Control* TRUCK (A-3)

NO SPRING PLATES—NO SPRING PLANKS



LONG SPRING TRAVEL · CONSTANT FRICTION CONTROL

AMERICAN STEEL FOUNDRIES

CHICAGO

Overhead. *G-E fluorescent lamps in continuous lines of light impart a cheerful atmosphere to this dining car interior. G-E incandescent lamps give added down light over the tables.*

Good lamps are the heart of good lighting

FILAMENT

FLUORESCENT

SLIMLINE FLUORESCENT

The Constant aim of General Electric Lamp Research is to make G-E Lamps Stay Brighter Longer

For tomorrow, G-E Slimline lamps will join with G-E fluorescent and filament lamps to bring you new help, greater service from lighting.

G-E LAMPS

GENERAL ELECTRIC

HOW TO LIVE COMFORTABLY—
—at 60
THE DRAWINGROOM-BEDROOM CAR
Another new idea that will make railroads
tomorrow's preferred form of travel

. . . and the world's most dependable under-car drive guarantees that comfort!

Yes . . . whether you're speeding along at 60 miles an hour or faster, you'll live in gracious comfort in this newest creation of railroad car designers. By day a luxurious, spacious drawing room, by night a comfortably-appointed bedroom . . . with a private, enclosed bath attached. It's travel comfort *de luxe*. That is, it is if the under-car drive that provides the power for air conditioning, lighting, and other electric requirements does not fail. Because this power source must not fail, forward-thinking railroad car designers and managements are specifying more Dayton "D-R" V-Belt Axle Drives for luxury cars than any other make. They know that these Dayton Drives provide the highest performance and safety factors of any under-car drive built. Let a Dayton railway specialist show you proof why Dayton "D-R" V-Belt Axle Drives are preferred two to one. Write to

THE DAYTON RUBBER MANUFACTURING COMPANY
DAYTON 1, OHIO

Railroad V-Belts by

Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

THE MARK OF TECHNICAL EXCELLENCE IN SYNTHETIC RUBBER

Advantages of the Dayton "D-R" V-Belt Axle Drive

1. *Quiet and smooth performance with high availability—in 15 years a mechanical failure due to V-Belts has never been reported.*
2. *Provides a flexible, cushioned connection between the car axle and the driven unit that protects generators and other equipment should a mechanical failure occur.*
3. *It is convenient and economical to install . . . no complicated or expensive truck changes are necessary . . . no special axles are necessary.*
4. *Duplicate equipment is not necessary to take care of emergencies—when wheel changes must be made, only the axle pulleys need to be removed.*
5. *It greatly reduces maintenance cost on mechanical equipment as well as on the drives themselves.*
6. *It imposes a minimum weight on the car axle.*
7. *It is easy and simple to install, safe and dependable in operation, and insures uninterrupted performance.*

★ 40 YEARS OF RESEARCH IN NATURAL AND SYNTHETIC RUBBER ★

MAKERS OF *History*—

Chicago and North Western—Union Pacific "City of Denver" and "City of Los Angeles" meeting in Chicago

Here are makers of railroad history . . . streamliners that regularly maintain whirlwind schedules on two of America's longest, toughest runs. A 1047-mile dash daily between Chicago and Denver . . . a 2299-mile race between Chicago and Los Angeles every third day! These are triumphs of Chicago and North Western—Union Pacific operation of crack fleets.

Back of this success is Diesel dependability . . . and *correct* lubrication. Chicago and North Western and Union Pacific use Sinclair Gascon Oil for lubrication of the Diesel locomotives hauling these outstanding trains.

Sinclair Gascon gives cool engine operation with absence of deposits that cause ring sticking and carbon troubles. Its wear-prevention qualities hold down expensive replacements. Let our Engineers tell you more about the advantages of using Sinclair Gascon Oils.

SINCLAIR RAILROAD LUBRICANTS

SINCLAIR REFINING COMPANY, *RAILWAY SALES*, NEW YORK • CHICAGO • SAINT LOUIS • HOUSTON

Only Honeywell Offers

"FULL MODULATION"

DIESEL ENGINE SHUTTER CONTROL

Full modulation control means accurate and positive positioning of the diesel engine radiator shutters. It means that only enough air is permitted to pass through the radiators to maintain engine cooling water and oil temperatures at exactly the degree required, regardless of outside temperature, speed or load conditions.

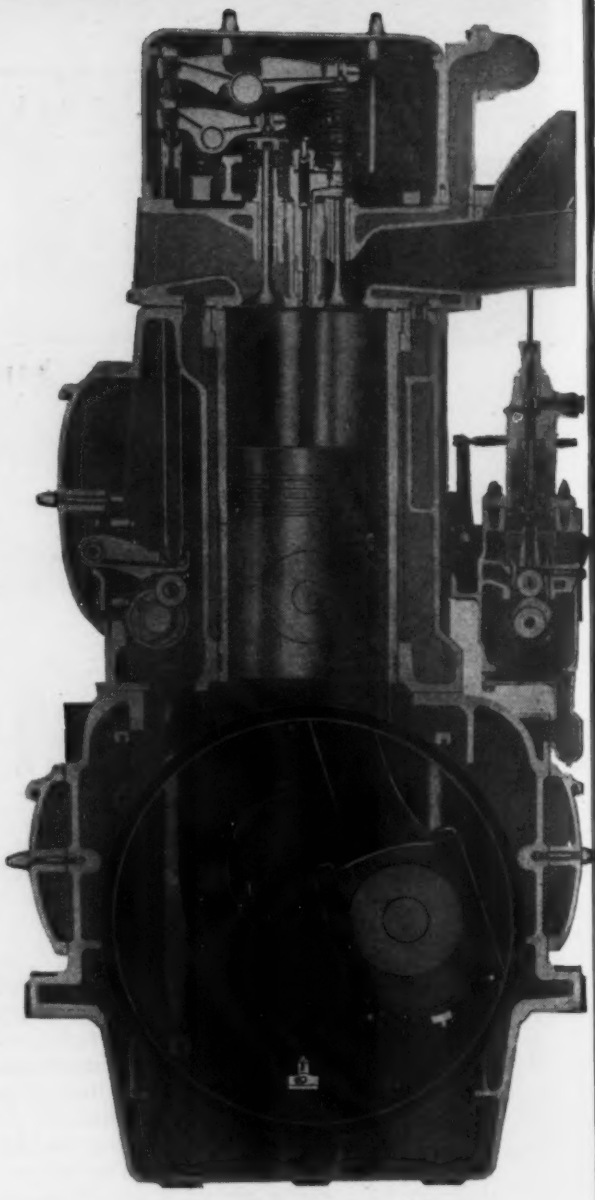
Contrast full modulation control to the conventional "off-on" system, which means periodic delivery of cooling air with an alternately hot and cold engine cooling water condition, which obviously cannot be as efficient as constant proper temperature.

The modulating feature of the Honeywell Shutter Control System makes possible not only full modulation of the shutters, but also permits step or sequence control of shutters and fan operation. Honeywell full modulation control is fully automatic. It is simple, safe and foolproof, as evidenced by hundreds of thousands of miles of actual service on freight and passenger runs from coast to coast and from Canada to the Gulf, under all types of varying weather and load conditions.

If you are not already familiar with the Honeywell full modulation diesel engine shutter control system, write Minneapolis-Honeywell Regulator Company, Railway Controls Division, 433 East Erie Street, Chicago 11, Illinois.

NOW AVAILABLE

Extra Protection for Diesel Engines



Protect the heart of your Diesel Engines by installing the Bearing Watchdog System. With this tried and proved crankshaft protector, wear beyond predetermined limits or shellout of connecting-rod and main bearings can be detected in plenty of time to prevent any damage to the crankshaft.

The system can be operated either pneumatically or hydraulically. Under pneumatic operation, it is connected to an external air supply, and a constant air pressure of from ten to fifteen pounds is normally maintained. No electrical circuits enter the crankcase.

An adjustable "watchdog" or trip-lever installed under each connecting-rod throw, and a lug attached to each connecting-rod bearing cap, provide the points of contact which sets the system into action. Other units of the system include a dump-valve which can be attached to the Serv-O-Motor of any standard hydraulic governor, and a control box containing an air-pressure reducing valve and tell-tale light. The various parts are connected by copper tubing.

Allowing for expansion and flexing in the engine, the clearance between the Watchdog and the lug is set to represent the maximum amount of wear permissible. If a connecting-rod bearing or main bearing wears excessively or shells out, the lug strikes and trips the Watchdog, releasing the pressure from the system which activates the dump valve on the governor. This effects an immediate engine shutdown and simultaneous lighting of the tell-tale light.

Protection is also afforded if a main bearing goes out, because the crankshaft will flex sufficiently to trip the Watchdog. The engine is protected in case of broken connecting-rod caps, broken cap-bolts or connecting-rods, because anything that releases the air pressure from the Watchdog System causes an almost instantaneous engine shutdown.

Write today for illustrated folder and complete details about this important crankshaft protector!

- PROTECTS THE CRANKSHAFT
- PERMITS MAXIMUM BEARING WEAR
- MAKES FREQUENT BEARING INSPECTION UNNECESSARY
- LOCATES FAULTY BEARING INSTANTLY
- OPERATES EITHER HYDRAULICALLY OR PNEUMATICALLY
- SIMPLE . . . POSITIVE . . . HAS LOW MAINTENANCE FACTOR
- PROTECTS THE ENGINE

We invite inquiries from Diesel Owners and Operators, Diesel Designing Engineers and Diesel Manufacturers.

PAXTON DIESEL ENGINEERING COMPANY–OMAHA 5, NEBRASKA ★ *A Subsidiary of Paxton-Mitchell Company, Mfgs. of P-M Metallic Rod Packing*

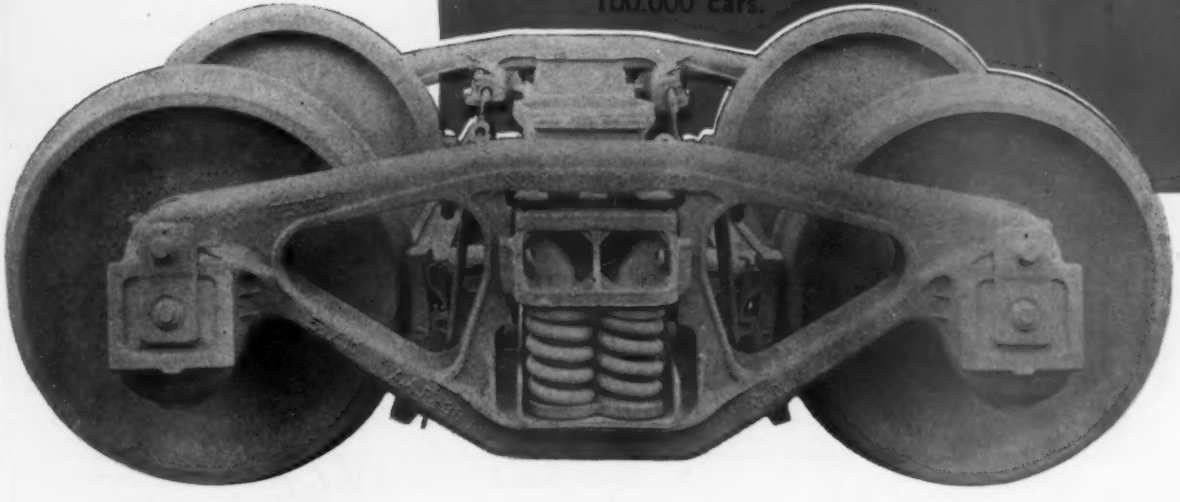
BEARING WATCHDOG SYSTEM

"Stabilized"

means "an asset!"

Webster's may not define it that way, but "STABILIZED" means "an Asset" to the railroad and to the shipper when it is used in Barber STABILIZED Trucks. Barber STABILIZED Trucks by controlling the ride of freight cars assure the shipper that goods will reach their destination safely. Barber STABILIZED Trucks by preventing harmonic bounce, bolster and column wear and spring breakage assure the railroad economic operation.

Yes, 56 different railroads and private car lines have found that "STABILIZED TRUCKS" means "an Asset" because they have now been supplied for over 100,000 cars.



STANDARD CAR TRUCK COMPANY

332 SOUTH MICHIGAN AVENUE CHICAGO 4, ILLINOIS

Stop Coil Springs from Jitterbugging!

★ This is what Oscillation Curves prove about the movement of your coil spring groups in operation.

A. A. R. STANDARD SPRING GROUP WITHOUT HOLLAND SNUBBERS

HOLLAND SNUBBER SPRING AND 3 A. A. R. SPRINGS

Style A-6-A Holland *Volute* Snubber Springs

HOLLAND COMPANY

332 SOUTH MICHIGAN AVENUE, CHICAGO, ILLINOIS

WE DON'T LET 'EM DOWN WHEN THE TEMPERATURE GOES UP!

Sturtevant Air Conditioning Makes High Temperature Shut-Offs A Thing of the Past!

HERE IS AN AIR CONDITIONING SYSTEM that will keep running *without interruption* – even when you're operating in the highest ambient temperatures to be found in the United States. You can forget about exceptionally high outside temperatures – such as you find in the southwest–that would ordinarily cut-out the system.

With the Sturtevant Evaporative-Condenser Unit, an extra cooling effect produced on condenser coils liquifies the Freon gas inside, and reduces pressure to a level well under safety limits. Suspended underneath the car, the Evaporative-Condenser sprays large quantities of water over the coils, then evaporates the water with a blast of air. Built for continuous operation over great distances, the unit is provided with a 175-gallon stainless, leak-proof, steel tank which supports a motor driven pump.

This Unit is but one of several new types of Sturtevant Railroad Equipment. Whether your operations demand simple pressure ventilation or a complete air conditioning system, it will pay you to talk with a Sturtevant Engineer.

B. F. STURTEVANT COMPANY
Division of Westinghouse Electric
HYDE PARK BOSTON 36, MASS.
Branch Offices in Principal Cities

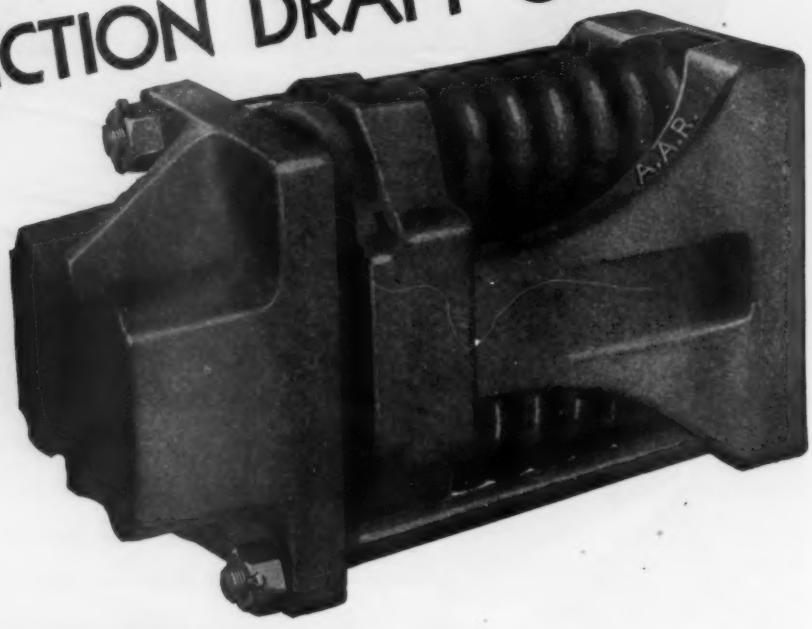
STURTEVANT GIVES YOU ALL 4 RAILROADING ADVANTAGES

1. More uniform temperature and humidity conditions in the car.
2. Equipment designed for easy maintenance.
3. Equipment designed for minimum space and weight.
4. Equipment that requires a minimum power load.

Sturtevant
Puts Air to Work

STURTEVANT "Railvane" Units or Systems are used by 40 railroads and are covered by more than 80 issued patents and patents pending

NATIONAL FRICTION DRAFT GEARS



NATIONAL M-17-A DRAFT GEAR
22 3/8" long
A.A.R. Approved

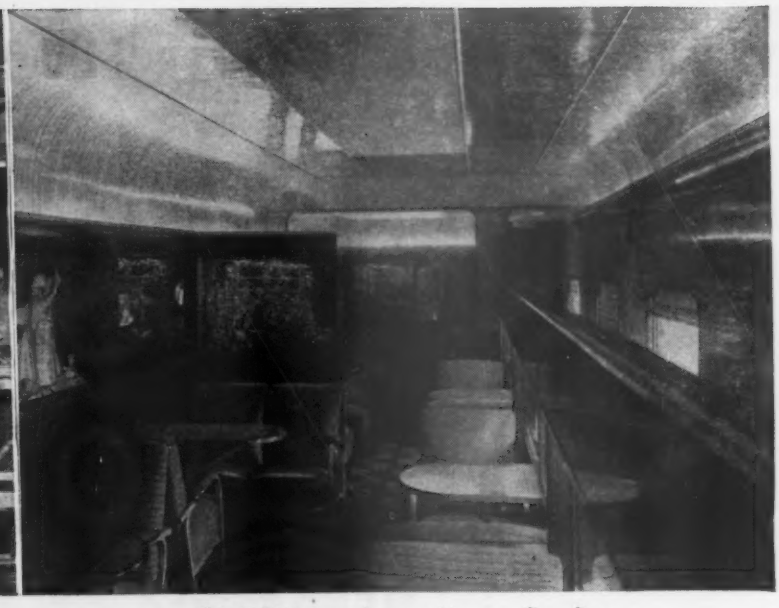
NATIONAL M-50-B DRAFT GEAR
20 1/8" long
A.A.R. Approved

NATIONAL K-4 DRAFT GEAR
Designed especially to meet the requirements of high speed passenger service.

Specify NATIONAL Draft Gears for efficient, economical service.

NATIONAL MALLEABLE AND STEEL CASTINGS CO
General Offices: CLEVELAND, OHIO
Sales Offices: New York, Philadelphia, Chicago, St. Louis, San Francisco
Works: Cleveland, Chicago, Indianapolis, Sharon, Pa., Melrose Park, Ill.

Coffee shop car with narrow Multi-Vent panels



Plain Multi-Vent panels as used in an auxiliary diner

proved passenger comfort

Multi-Vent panels with incandescent lighting fixtures, in deluxe coach

MULTI-VENT is an exclusive method for delivering air through ceiling panels to occupied spaces. It provides the efficient air distribution, without drafts, required for passenger comfort in modern railway equipment.

MULTI-VENT draftless ventilation is serving in many hundreds of cars, in all parts of the country, and has proved its ability to provide uniform temperatures and all the other features contributing to comfort.

MULTI-VENT is easily installed in any type of car and can be used with any type of lighting equipment. Write for Bulletin No. 6110 giving examples of many types of applications.

The Pyle-National Company

1334-58 NORTH KOSTNER AVE. • CHICAGO 51, ILLINOIS

OFFICES: NEW YORK • BALTIMORE • PITTSBURGH • ST. LOUIS • ST. PAUL • SAN FRANCISCO

Export Department: International Railway Supply Co., New York

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YOUR PASSENGERS PREFER FLUORESCENT LIGHTING

RAILWAY FLUORESCENT LIGHTING NEEDS E·L DC-AC CONVERTERS

In the competitive transportation field of today modernization is recognized as a necessity. For passenger illumination the trend is definitely toward fluorescent lighting.

E·L VIBRATOR CONVERTERS MOST EFFICIENT. E·L Vibrator Converters are the most efficient and economical means of providing your coaches, diners, lounge cars and sleepers with modern fluorescent lighting.

FOR RADIO EQUIPMENT, TOO. Two-way radio operation of trains is also provided for by the E·L Vibrator Converter. It is likewise the means of giving your passengers the extra convenience of standard radio reception and electric razor outlets.

DESIGNED FOR RAILWAY USE. With railway needs in mind, E·L developed a compact, lightweight power conversion system. It operates ten 42" Slim-Line fluorescent lamps from 32 volts DC or any other input voltage desired. For larger number of lights, multiple units may be used.

This E·L system incorporates dual series circuits and the simplicity of series wiring. It provides more than 30 lumens of light per input watt as compared with less than 15 lumens per watt for old fashioned incandescent types. Individual lamp control is available where required and a constant level of light is assured by inherent voltage regulation.

TESTED IN RAILWAY USE. In actual railway car installations, E·L Vibrator Converters have been tested and reliability thoroughly proved over a period of years.

For railway fluorescent lighting, you need E·L DC-AC Converters.

E·L FLUORESCENT DC-AC CONVERTER. Model 2026 operates ten 42" Slim-Line fluorescent lamps. Providing instantaneous starting and high efficiency, it is available for these input voltages: 12, 24, 32, 110, or 600 volts DC.

Dimensions are 14⅝ x 13 x 8.

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Electronic
LABORATORIES, INC.
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VIBRATORS AND VIBRATOR POWER EQUIPMENT FOR LIGHTING, COMMUNICATIONS, ELECTRIC AND ELECTRONIC APPLICATIONS

DEADWEIGHT CUT 26%
IN TWENTY-FIVE NEW HOPPER CARS

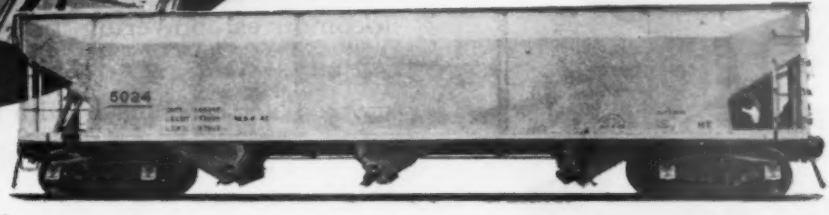
MADE OF

Alcoa Aluminum

Twenty-five 70-ton hopper cars made of Alcoa Aluminum by the American Car and Foundry Company for a leading southwestern railroad are now off the production line. Aluminum alloy is used for the entire body of these cars, except the center sill and bolster, which are made of steel.

Average scale weight, empty, is 37,000 pounds per car, compared with an average of 50,100 pounds for the conventional all-steel 70-ton hopper car —a saving of 26% in deadweight. The aluminum car carries 6½ tons more than the corresponding A.A.R. steel car without imposing any more weight on the axles and without requiring any more locomotive power. Cars are equipped with Type AB Empty and Load Brake.

These aluminum hopper cars were designed to purchaser's specifications by American Car and Foundry Company and Alcoa engineers. ALUMINUM COMPANY OF AMERICA, 1929 Gulf Bldg., Pittsburgh 19, Pa.



MADE OF ALCOA ALUMINUM; WEIGHS ONLY 37,000 POUNDS

ALCOA ALUMINUM

ALCOA

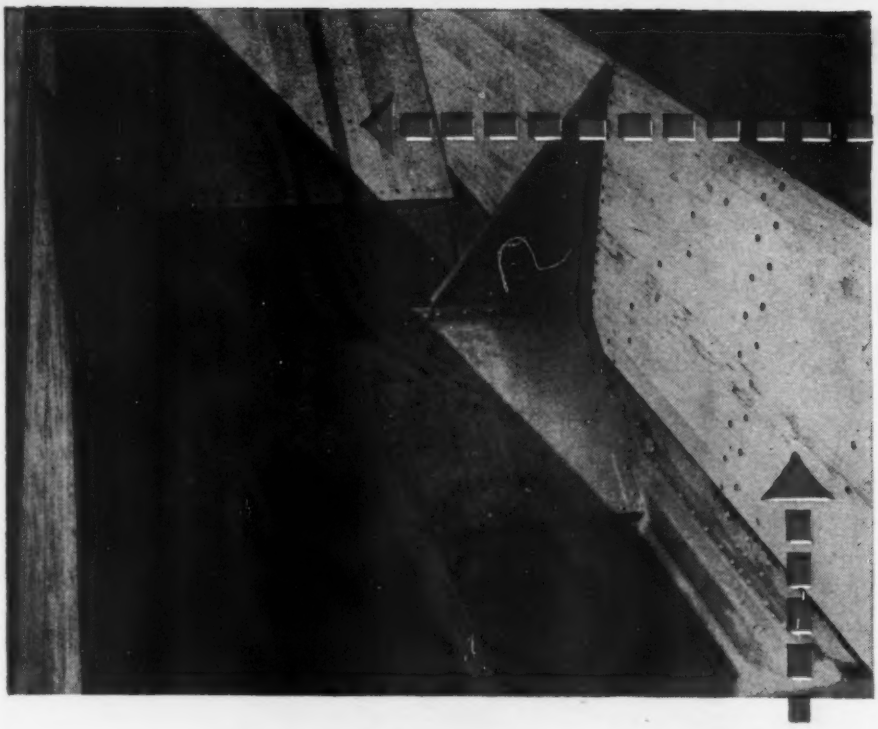
Specify EXIDES wherever this symbol appears in your plans

Extra electrical innovations, which form a part of most plans for the fine new cars soon to come, call for added power—trustworthy and economical power. All are assured when Exide batteries are specified.

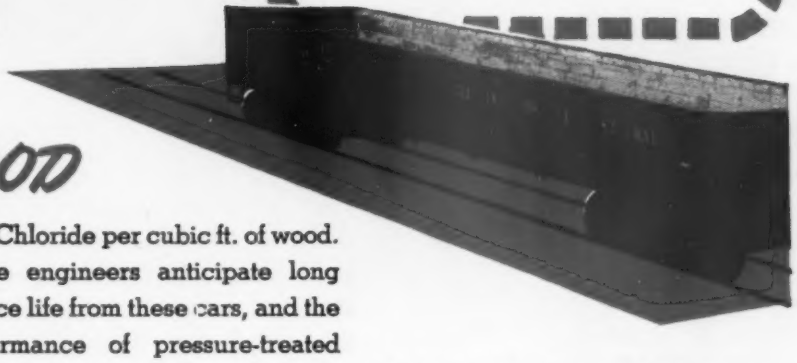
On thousands of coaches and Pullmans, Exide Ironclads are keeping cars bright and air-conditioning units functioning smoothly even during long stops. They are cranking Diesel locomotives, powering train telephones and signal systems. And Exides will serve tomorrow's greater needs with the same dependability, long-life and ease of maintenance as they have since 1891.

Exide
IRONCLAD
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • Exide Batteries of Canada, Limited, Toronto



500 Coal Cars equipped with "Life Preservers" by the Illinois Central Shops



KOPPERS PRESSURE-TREATED WOOD

This composite hopper-bottom car is one of 500 coal cars built at the Centralia, Illinois shops of the Illinois Central Railroad, in which pressure-treated wood was used for composite bottoms and sides.

Dense short-leaf yellow pine, pressure-treated with creosote to a final net retention of 6 lb. per cubic foot, was installed in the car bottoms. Sides, which were also dense short-leaf yellow pine, were pressure-treated with ¾ lb. Chromated Zinc Chloride per cubic ft. of wood.

The engineers anticipate long service life from these cars, and the performance of pressure-treated wood in other applications certainly justifies this expectancy. Wherever car material, notably decking, must take severe mechanical punishment or is subjected to decay, pressure-treated wood has given from two to three times the service of untreated material. Many so-called "mechanical" failures are actually induced by decay, which is combatted by proper treatment. The treated wood is not subject to corrosive attack, first cost is low, and maintenance is held at a minimum.

We will be glad to send you information on typical treatment specifications used by representative railroads, if you will write.

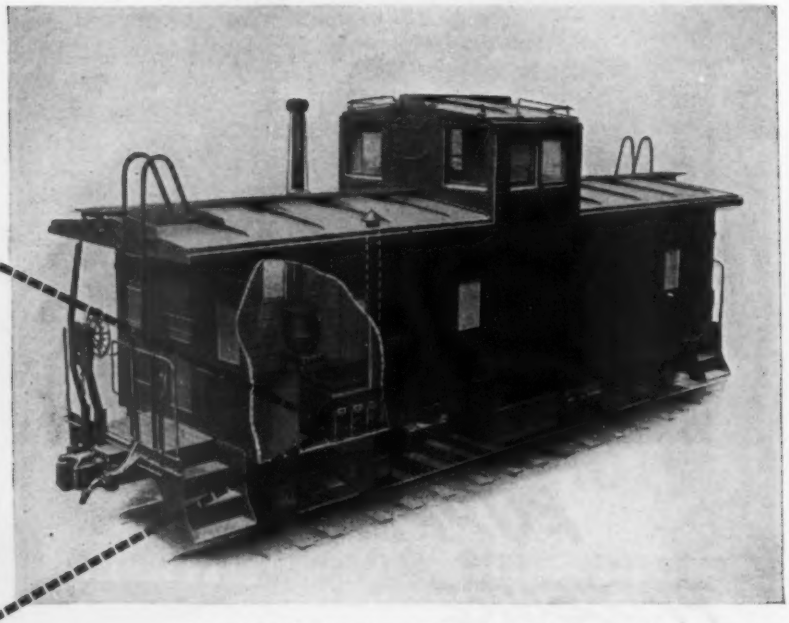
KOPPERS COMPANY, INC. • WOOD PRESERVING DIVISION
PITTSBURGH 19, PA.

KOPPERS

Buy Victory Bonds —and Keep Them!

THE INDUSTRY THAT SERVES ALL INDUSTRY

You get these...
8 IMPORTANT ADVANTAGES
when Alkaline Batteries ride the Caboose



Typical installation of an alkaline battery under a caboose seat bunk

A 25-cell, 32-volt alkaline battery

As a POWER source for train communication equipment on caboose cars, Edison Alkaline Batteries provide the same outstanding advantages that account for their fine performance and long service records on railway passenger cars. Their construction and inherent operating characteristics . . . listed at the right . . . are your assurance that they will give (1) longer service life than can be obtained from other types of batteries, (2) unequalled dependability and (3) low operating costs.

Ask for Bulletin S. B. 1005. It is prepared to provide railroad and equipment manufacturers with electrical data, dimensions and weights for selecting batteries for this service. Edison Storage Battery Division of Thomas A. Edison, Incorporated, West Orange, New Jersey.

Edison
ALKALINE BATTERIES

- Alkaline batteries are *light in weight.*
- They are *durable mechanically;* because of their steel cell construction, they will withstand successfully the mechanical shocks incidental to freight train operation.
- They are *foolproof electrically;* are not injured by excessive charging or by overdischarging which are likely to occur as a result of run variations whether the caboose car is provided with generating equipment or the batteries are charged from yard power.
- They accept *charge rapidly;* can be completely charged at full normal rate up through the finish, or at higher rates for short periods regardless of state of charge.
- They *resist temperature extremes;* are not subject to injury by freezing.
- They can *stand idle indefinitely* without injury. Merely discharge, short-circuit, and store in a clean, dry place.
- They are *free from corrosive acid fumes;* may be installed in close proximity to delicate apparatus.
- They are *simple to maintain.*

SCULLIN MEANS STAMINA IN LOCOMOTIVE CASTINGS

Relentless Tests Show Strength to Spare

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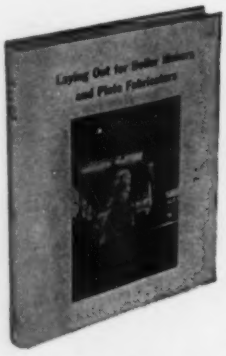
LAYING OUT for BOILER MAKERS AND PLATE FABRICATORS



1944. 5th. 522 pages, 762 scale drawings, 20 photographs, index, 8½ x 11¼, $8.00

This standard layout book, first published in 1907, has been thoroughly revised and brought up to date. The locomotive boiler chapters have been expanded and new chapters added to cover Laying Out and Computing Boiler Patches and Laying Out for Welded Construction. Original chapters on sheet metal layout have been left in and layouts for plate fabrication added. The text has been entirely reset in easy reading type and the all new line drawings are sharp and clear. Written in shop language and without resort to higher mathematics.

Contents

The Subject of Laying Out—Triangulation—Cones and Spheres—The Tubular Boiler—Laying Out the Locomotive Boiler—Constructing the Locomotive Boiler—Laying Out and Computing Boiler Patches—Laying Out for Welded Construction—Elbows—Layout and Construction of Steel Stacks—Transition Pieces and Breechings—Pipe and Pipe Connections—Chutes, Conveyors, and Hoppers—Index.

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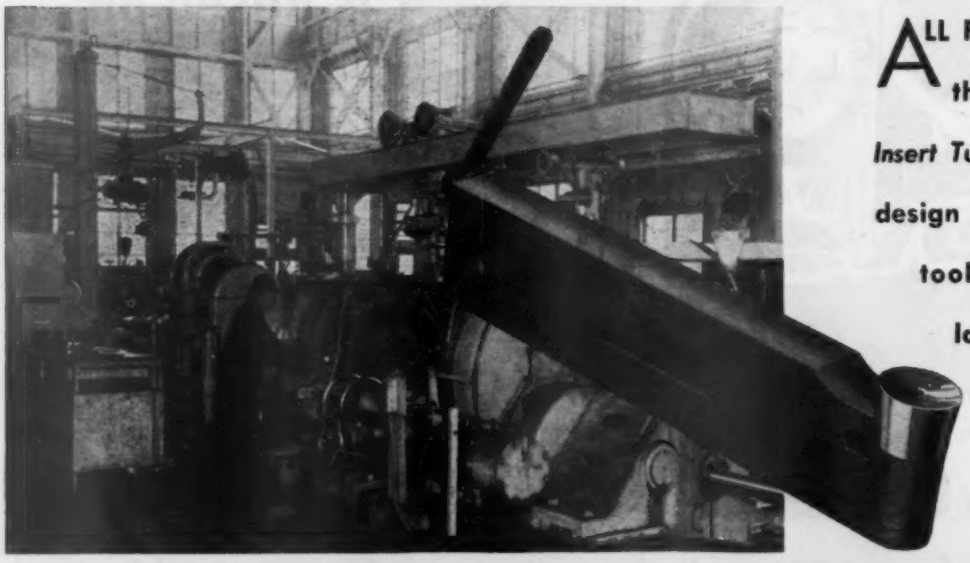

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Hardened and Ground Steel Pins and Bushings . . .

for Diesel and steam locomotives and tenders, and passenger and freight cars

XLO
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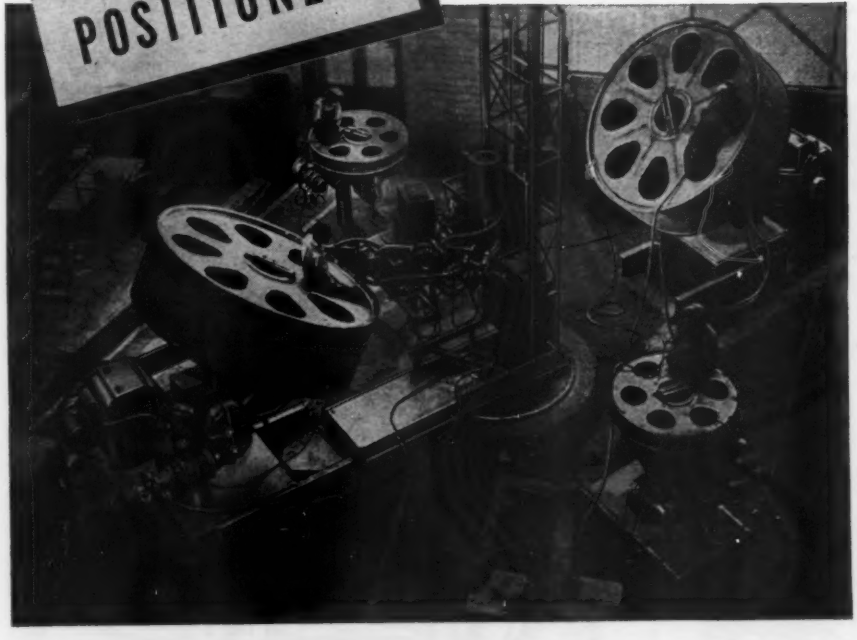
Railroad Division

EX-CELL-O CORPORATION

Detroit 6, Michigan

C-F POSITIONERS



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A "double production line"—in a 30 ft. square space handles all of the progressive steps of building up 2 sizes of large turbine gears simultaneously.

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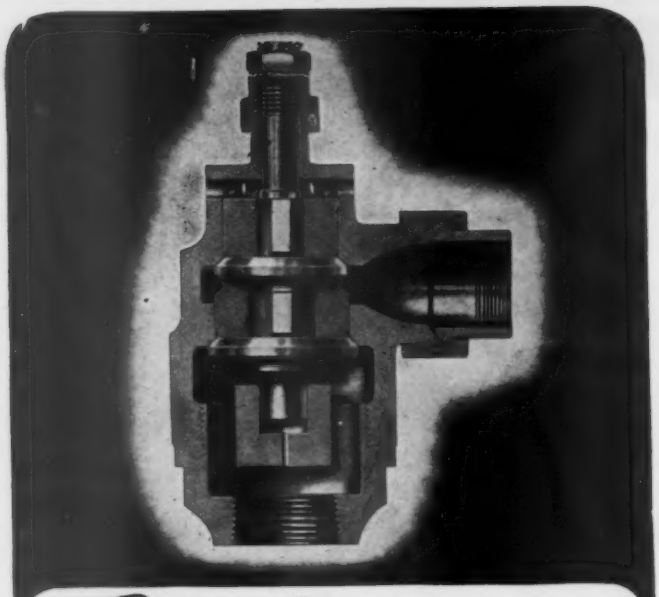
Write for Bulletin WP-22

CULLEN-FRIESTEDT CO. 1309 S. KILBOURN AVE. CHICAGO 23, ILL.



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BY-PASS VALVES

For Drifting Locomotives

These valves by-pass compression from one end of the cylinder to the other, and operate automatically with the throttle firmly closed, thus eliminating the use of steam while drifting. Vacuum is destroyed, lubrication is maintained, preventing the formation of carbon. This eliminates excessive wear on valve and cylinder packing, rings, and reciprocating parts. Operating tests have proven that a definite fuel saving results from the use of these valves; especially when drifting for periods of long duration. *Write for full particulars.*

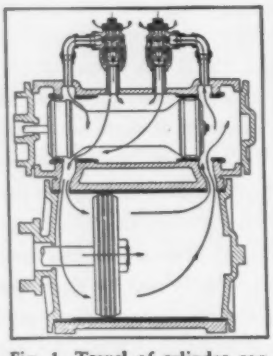

Fig. 1. Travel of cylinder contents at initial movement of piston while drifting. Reverse lever set at 50% cut-off. Main piston valve and both by-pass valves open.

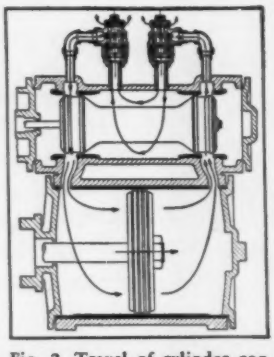

Fig. 2. Travel of cylinder contents with piston at 50% of stroke. Reverse lever set at 50% cut-off. Piston valve in lap position over cylinder ports and both by-pass valves open.

VILOCO RAILWAY EQUIPMENT CO.

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with self-contained semi-automatic RIDGID No. 65R

● Save yourself time and effort in threading 1", 1¼", 1½" and 2" pipe. This rugged steel-and-malleable 65R gives you precision threads faster and with less effort than you've thought possible. You like the 10 second setting to size with one set of chasers that stay in the die stock (no extra dies to bother with) and the instant-setting foolproof workholder. Precision cut high-speed steel chasers and factory testing of every threader assure you of clean perfect threads, smooth faultless operation. For quicker easier threading buy the 65R at your Supply House.

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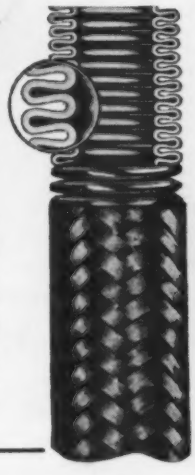
KING OF FLEXIBLE METAL HOSE!

● There are reasons for leadership in every line. Better performance, finer quality, greater versatility and dependability . . . these and many more have given REX-WELD Flexible Metal Hose the high reputation it has today. A reputation that has earned the confidence of industry everywhere. Industrial men know the advantages of REX-WELD. For this rugged, seep-proof, airtight product has been out-performing ordinary connections on a wide variety of applications throughout industry.

Let "Flexon," the C.M.H. trademark character, show you in the sketches below some of REX-WELD'S outstanding features. Then ask us to give you the full story about REX-WELD and the other flexible metal hose products in our complete line.



REX-WELD . . . Handles steam with utmost safety. It is seep-proof to gas, oil, water and searching fluids. It is highly rust-resistant and non-deteriorating.

REX-WELD . . . operates efficiently under pressures up to 5,000 p.s.i., temperatures to 1,000° F. Greater strength and durability are the result of its 50-50 principle of corrugation . . . of an autogenous welding process that makes the weld stronger than the tube itself.

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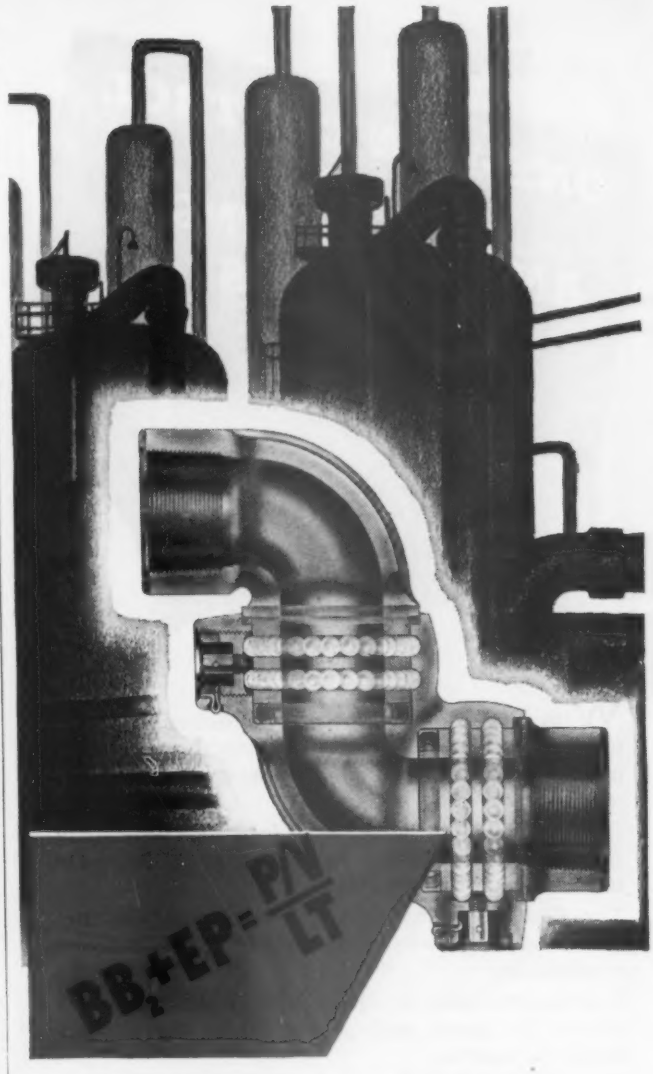

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for perfect flexibility meets every demand of industry

CHIKSAN **BALL-BEARING** Swivels got their start and built their reputation for perfect flexibility in the Petroleum Industry. As this Industry became more and more important as a vital source of materials for the manufacture of synthetic products, Chiksan Swivels have proved their adaptability to every need . . . wherever flexibility is required . . . on lines handling steams, acids, alkalies, chemical compounds, gas, gasoline, etc. Many new applications have been developed to speed up production for war and for peace. There are over 500 different Types, Styles and Sizes of Chiksan Swivels. Tell us your requirements and we'll be glad to suggest those best suited to your specific needs.

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EP = Effective Packing Element
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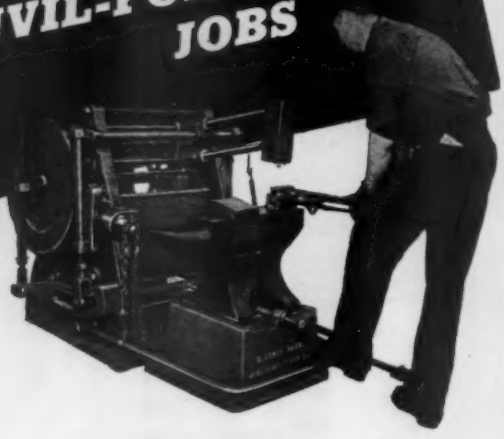
CHIKSAN — BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES — CHIKSAN COMPANY, BREA, CALIFORNIA

ONE-MAN CONTROL OF ANVIL-FORGING JOBS



With the McKiernan-Terry Blacker Hammer one smith alone can handle any hand-forging operation without need of helpers around the anvil.

He can complete *in one heat* jobs that ordinarily require several. Thus he can greatly increase anvil capacity and output.

The Blacker is the only direct-geared, electric-motor-driven power hammer—no belts, pulleys or clutches.

Coordinated with a regular blacksmith's anvil, it places its speed and power under the smith's absolute control.

It can deliver light taps, heavy blows or alternate light and heavy. Single blows or up to 140 blows per minute.

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Requires no special gadgets—just the smith's familiar anvil tools.

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ALL HAIR INSULATION FOR REFRIGERATOR CARS

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ONLY 5½ LBS.

Cuts steel up to 14 gauge without distortion

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ONLY 5 LBS.

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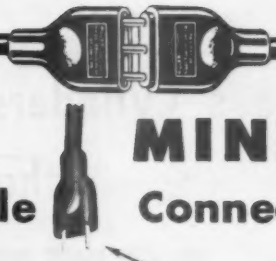
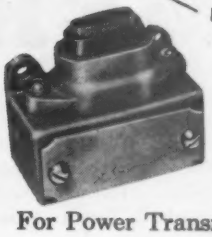


MINES Cable Connectors



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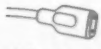
Single or Multi-Conductor

Heavy Duty

Water Sealed



Molded Rubber or Synthetic

Can Be Molded at Factory to Specifications on Your Cords or Cables

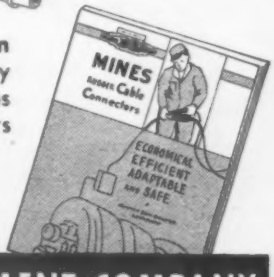
Stand Rough Handling and Difficult Conditions

Capacities from 5 to 500 Amperes

Voltages Up to 5000

Carried in Stock in Standard Designs and Sizes and Can Be Made Up Special to Meet Your Specific Requirements.

Write for Bulletin MC-106, showing many successful applications of Mines Connectors throughout industry.

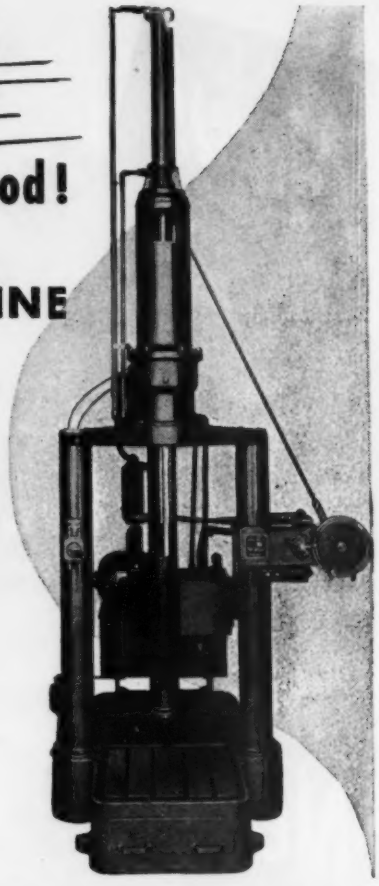


MINES EQUIPMENT COMPANY

4275 Clayton Ave. • St. Louis 10, Mo.

Finishes Cylinders FASTER— than by any other method!

FULMER HONING MACHINE



ON cylinder finishing operations the Fulmer Honing Machine *can remove material faster than by any other known method* for a given degree of accuracy and surface finish! Its use assures low maintenance costs in finishing cylinders, and longer operating life between major overhauls.

The Fulmer Honing Machine is capable of honing cylinders of all diameters encountered in railroad operation—Diesel liners, gas engine, air pump, air brake, stoker, reverse gear, piston valve and many other types of cylinders. It can be supplied in various sizes, with working strokes from 25" to 72", and with cylinder honing capacities up to 20" in bore.

The Fulmer Honing Machine is designed for heavy loads, continuous operation, and to deliver maximum torque into the spindle for fast stock removal. It is your best answer for accurate, rapid finishing of all internal cylinders.

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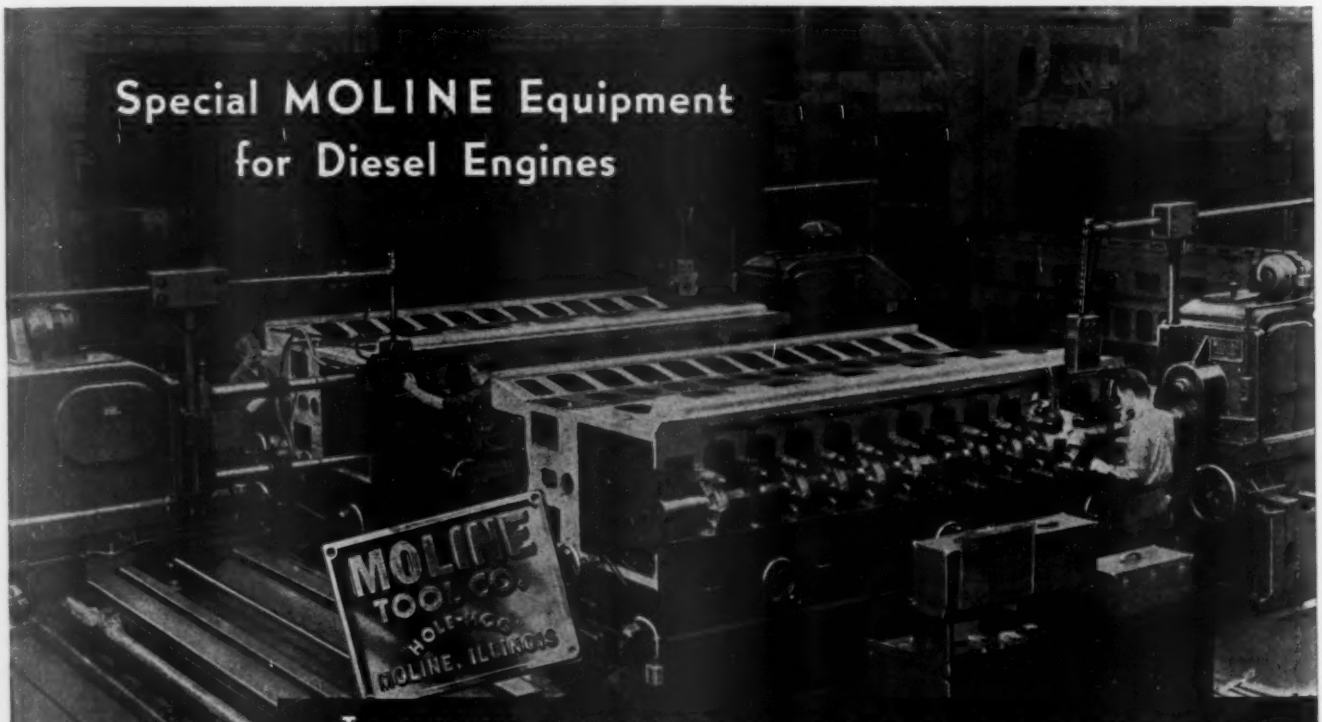
Special MOLINE Equipment for Diesel Engines



THE ABOVE PHOTO, taken in the Beloit, Wisconsin plant of Fairbanks-Morse and Company shows equipment furnished by Moline Tool Co. for the manufacture of Fairbanks-Morse opposed piston type Diesel engines which were used for power in submarines and Navy surface craft. These special Horizontal, Hydraulic Feed Boring Machines, the MR110 and the MR111, are here used together to bore the two crank and two cam lines in a large diesel engine block in one operation. The complete installation weighs approximately 124,000 pounds and covers a floor area of 38 x 22 feet. This type of completely automatic equipment may have many peacetime uses in your plant. Send for catalog sheets and complete details on this special equipment.

MOLINE TOOL CO. Moline, Illinois

OUT OF THE SHOP...

...QUICK!

The extra power of the Wilson E.P. and E.C.T. Series Air Motors permits fast removal of all types of deposits from straight or curved tubes of locomotive boilers. Valuable down time is saved by the non-stalling characteristic of these motors while the exclusive Wilson automatic valving of operating air cuts air consumption to a minimum.

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THOMAS C. WILSON Inc.
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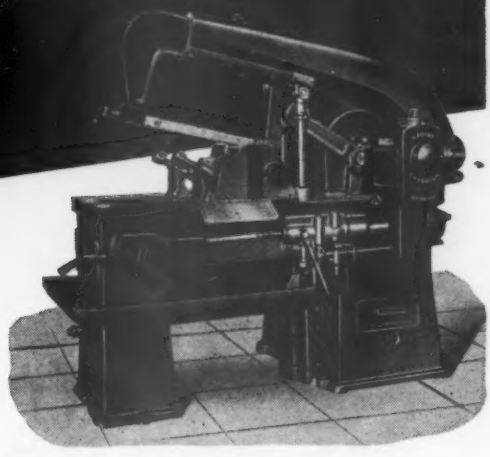
Pivoted Arm Construction Open Front Design

FOR MAXIMUM CUTTING EFFICIENCY



ALL RACINE Metal Cutting Machines employ "Pivoted Arm Construction and Open Front Design" combined with "Straight Line Pull on the Connecting Rod." Nearly forty years of research and manufacturing experience prove these principles correct.

The sketches below illustrate RACINE'S "Straight Line Pull" as opposed to angular pull. The connecting rod is parallel with the blade. Feeding pressure is directly against proper and adequate bearings provided to carry these loads. The blade is aligned with the exact center of the connecting rod. These features eliminate side and angular stresses, insuring a free running blade and the maximum in cutting speed and accuracy.

The following are added RACINE advantages — Progressive Feed throughout the cutting stroke. The open front facilitates loading. Removable front vise jaws. Replaceable table plates and wear plates on vise jaws. Tee slots in table plates to permit clamping of odd shaped work. Single lever hydraulic operation and control. All these contribute to the work capacity of this equipment.

The long experience and engineering skill that developed the efficiency of RACINE Machines can be applied to your metal cutting operations. Write for interesting Catalog No. 12. Include a brief outline of the work you have to do.

RACINE Pivot Arm Construction

Horizontal Cutting Construction

RACINE "Variable Volume" PUMPS

A Modern Source of Hydraulic Force

Smooth, oil-cushioned power for your oil hydraulic circuits. Pressures from 50 to 1000 lbs. Capacities 1 to 30 G.P.M. from *just one pump*. Request Catalog P-10-C for RACINE'S complete line of Pumps and Valves.

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★ RACINE'S Modern Design, with simple, single lever control, insures easy handling, lower cost per cut.

★ RACINE'S line is complete. Capacities 6"x6" to 20"x20". General purpose and high production type machines.

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All Standard Type Spring Plates produced for your requirements

Defect Card Holders made of heavy gauge, pressed steel construction.

Weatherproof. Large opening for convenient access.

The Above Equipment Fully Meets A.A.R. Requirements

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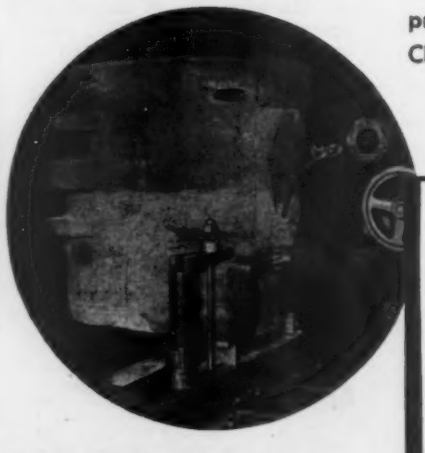
1. Three Bed Ways—span 44 inches.
2. Table Semi-Box design, heavily ribbed.
3. Motor mounted directly on base.
4. Saddle lead screw nut mounted between guiding ways.
5. Centralized right hand control.
6. Heavy duty type — heaviest 4" spindle machine built.
7. One shot lubrication for head; also for saddle and table assembly.



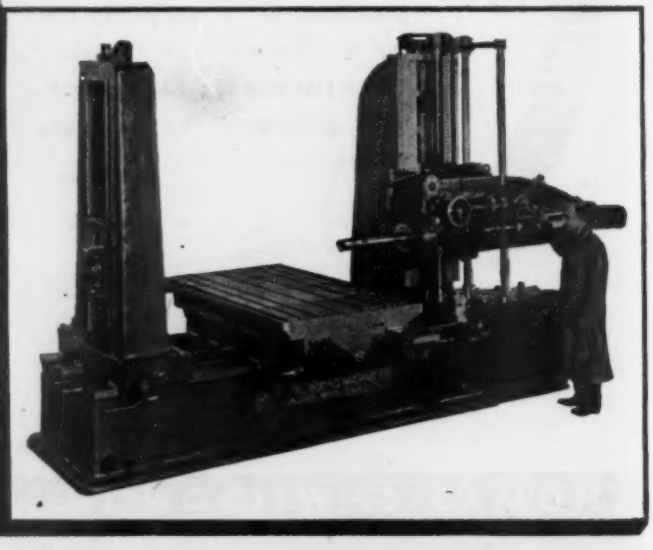
Railway construction and maintenance shops will find the UNIVERSAL BORING MACHINE a welcome addition, because of its versatility in precision machining operations.

This improved UNIVERSAL BORING MACHINE is available in 4" and 5" spindle sizes. Both are readily adaptable to do many boring, milling, turning, facing, recessing, and threading operations.

And UNIVERSAL can also show you how to handle many more precision jobs on a UNIVERSAL HORIZONTAL BORING MACHINE with the Tri-Way bed.

Write today for complete information.

◀ Milling Diesel Engine Frame for Switching Locomotive.



UNIVERSAL

BORING MACHINE COMPANY

HUDSON, MASS., U. S. A.

1576 ENGINE HOURS

. . . on one recharge set

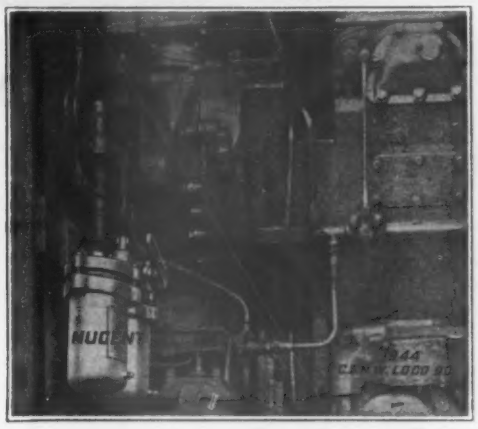
"No. 901"—a 900 h.p., 2 cycle Diesel switcher moving variable loads around curves and up and down ramps—recently operated 1576 engine hours without replacing the absorbent filter recharge in its Nugent Duplex Fuel Oil Filters. During this time 283,680 gallons of fuel oil were filtered and the engine consumed 8,012 gallons. The balance of the oil was by-passed back to the storage tank.

That's the kind of filtering that means maximum Diesel engine efficiency and the ultimate in oil conservation.

Get full details on the complete line of Nugent Fuel and Lube Oil Filters . . . write for Bulletin No. 7A.

WM. W. NUGENT & CO., INC.
EST. 1897
431 N. HERMITAGE AVENUE, CHICAGO 22, ILLINOIS

. . . and perfect filtration. That's the performance record of a NUGENT Duplex Fuel Oil Filter installed on the Diesel switching locomotive shown at left.



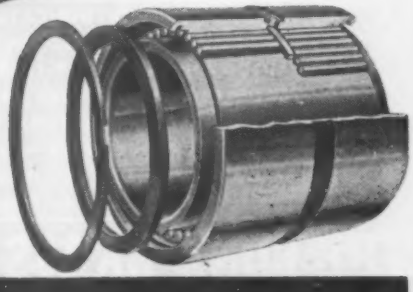
NUGENT TRADE MARK

The above view shows the Nugent Duplex Fuel Oil Filters installed in the Diesel locomotive shown at the left. The throw away type filter recharge used in these filters is easily and quickly inserted in the filter cage, assuring the user of constant, thorough filtering.

NUGENT FILTERS

5 Points of Superiority in Baker Valve Gears

The new Baker Valve Gear has five points where McGILL *MULTIROL* Bearings may be applied. Thus great savings in maintenance plus large increases in mileage are effected. Baker Valve Gears and McGILL *MULTIROL* Bearings make a record-breaking team. 500,000 miles and more without attention is not unusual.



Special Bearings can be made to suit any unusual condition and to answer any specific problem. Write the McGILL Manufacturing Company, Inc., Valparaiso, Indiana for information.

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AUTOMATIC AUXILIARY LUBRICATOR

PROVED BY YEARS of Trouble-Free Service

..ON AIR PUMPS
..STOKER ENGINES
..FEED WATER PUMPS

The Edna Automatic Auxiliary Lubricator provides positive lubrication for a locomotive whether running or standing. Extremely simple in construction, the Edna Lubricator has only two wearing parts — proved by years of service to be trouble-free. Extremely low in initial cost, this device requires minimum attention and maintenance, consumes oil without waste. Used by leading railroads. Write for Bulletin A-100B giving complete details.

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VALVES • COCKS: CYLINDER — GAUGE — TANK
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"EDNALOY" CASTINGS

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Sales Agent of National Lead Company

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Experience has shown that Hemingray Insulators never fail to render dependable, long-life service.

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Many of these famous insulators are still in service after 20, 30—and even 50 years.

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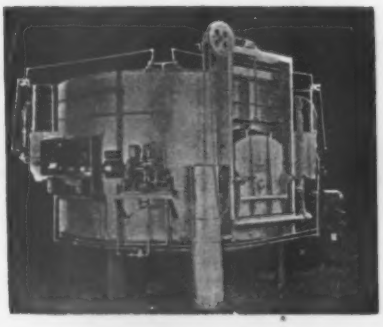
SPECIFY **JOHNSTON FURNACES** for SPRING SHOPS

SPRING HARDENING

Rotating hearth. Time for heating plates can be adjusted to suit and will remain constant.

Write for Bulletin R-246



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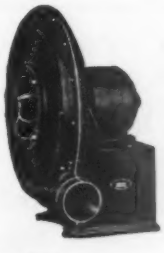

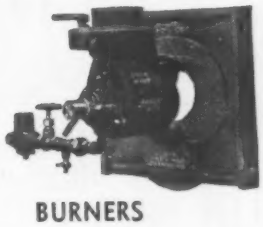

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BURNERS

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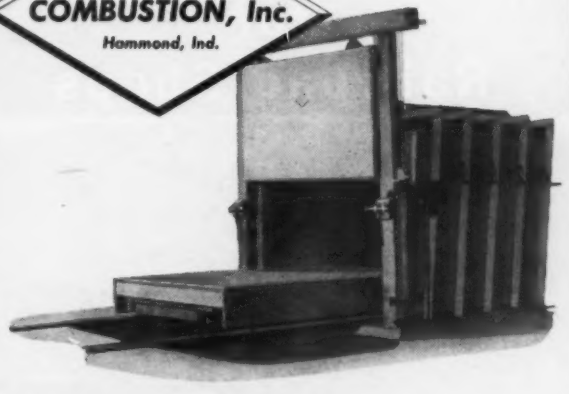

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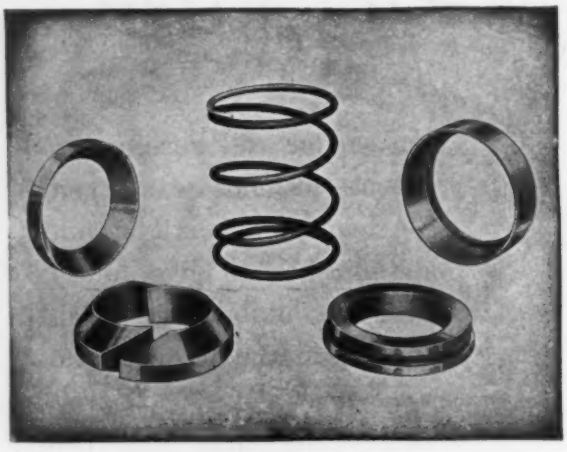

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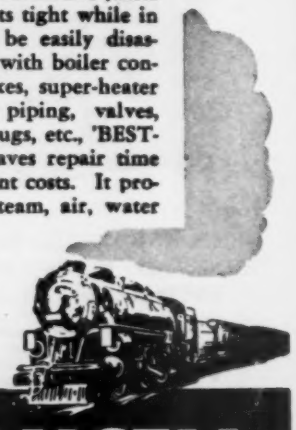

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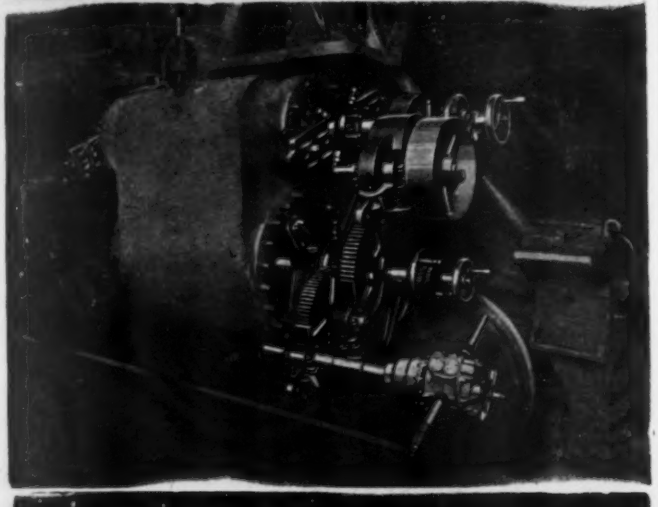

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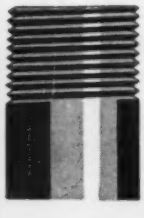

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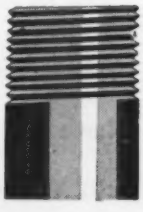

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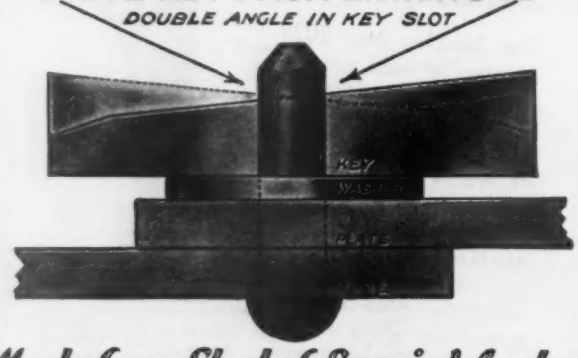

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American Railway Products Co.
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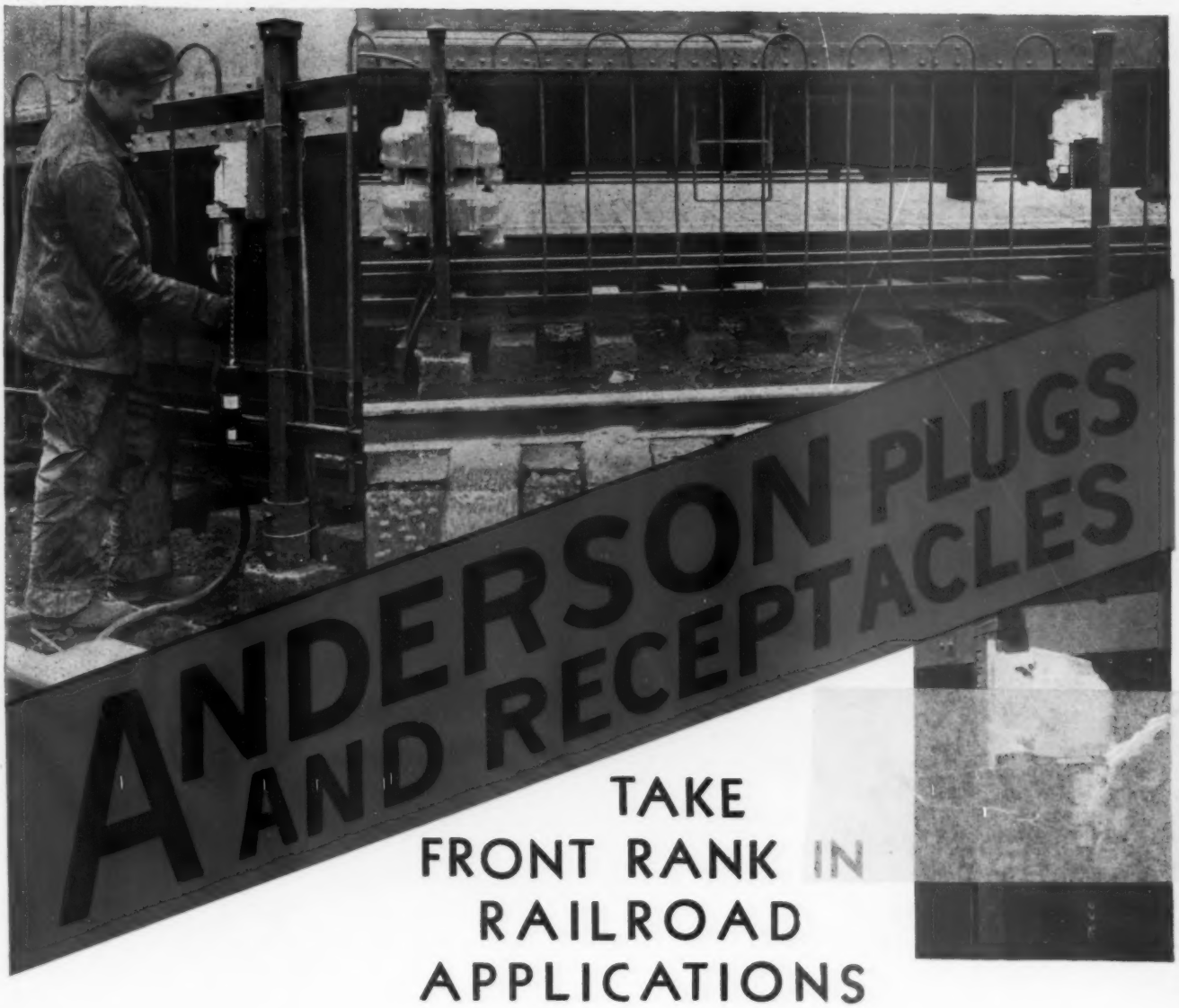

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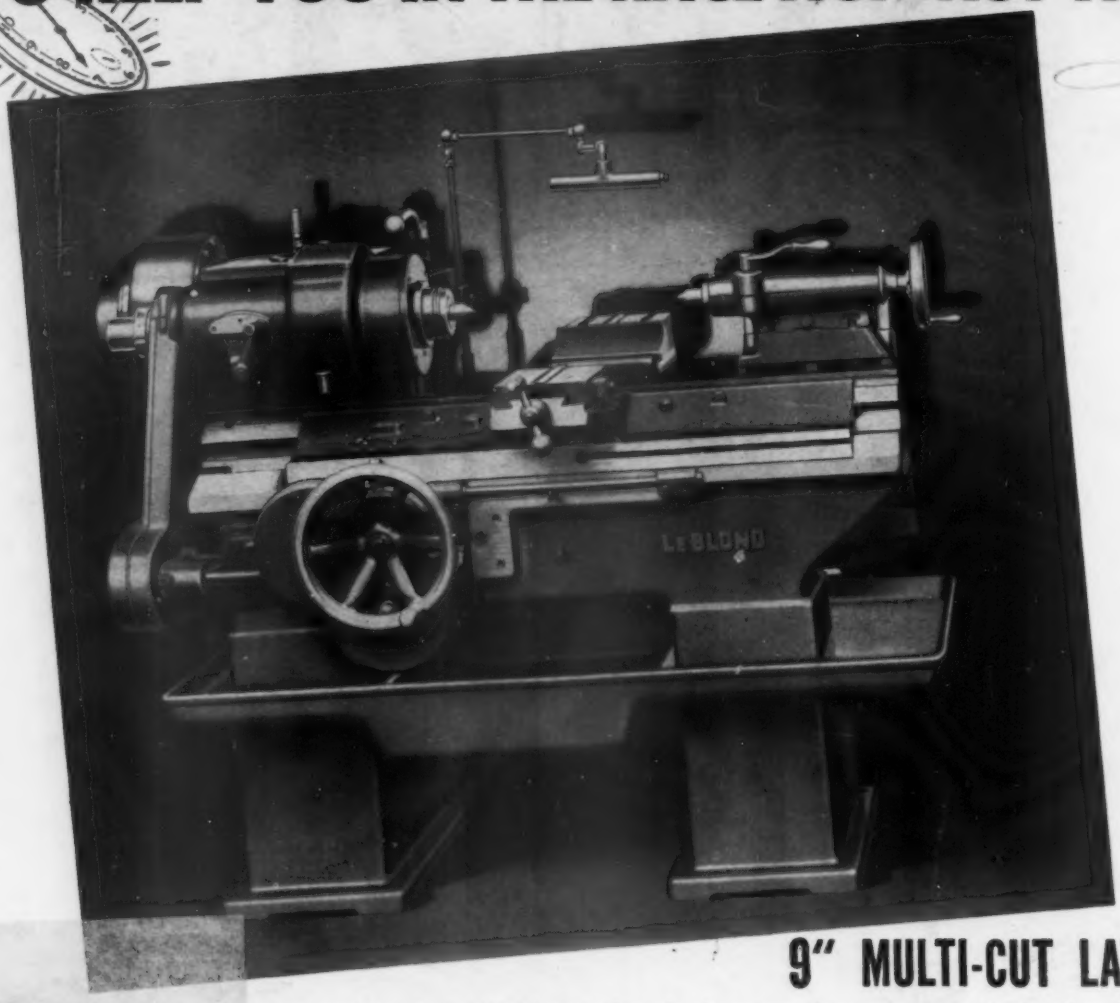

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